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A
DISSERTATION
ON THE
UNIVERSE IN GENERAL,
AND ON THE
PROCESSION OF THE ELEMENTS
IN PARTICULAR.

BY

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PREFACE.

IT is one of the great errors of the preſent age, that the ſtudy of natural philoſophy is confined to the inveſtigation of matter and ſenſible objects, and that the ſpeculation of intelligibles is neglected or deſpiſed. In *ſenſibles* we can only behold effects, whereas *intelligibles* contain the efficient cauſes of things. As the former are infinite in their nature, and indefinite in their qualities, it is impoſſible that they can ever become the real objects of ſcience; for ſcience is the knowledge of things definite and conſtant: it therefore does not proceed to inveſtigate cauſes through the medium of effects, but eſtabliſhes principles of a definite and poſitive nature, which lead to a knowledge of infinite particulars.

It was the practice of the ancients to reaſon from propoſitions to concluſions through proper media, but it is the habit of the moderns to aim at eſtabliſhing cauſes through the multiplicity of effects: the objects of ſpeculation of the former began where thoſe of the latter find their completion. Thoſe ancient ſages contemplated *wholes* and the principles of things; but the moderns examine the nature of *particulars* only, and the relation they bear each other. The former diſcovered what divine revelation has ſince proclaimed; they diſcovered the immateriality and conſequent immortality of the ſoul, and the connecting chain that links between God and man: but the moderns, by beginning and ending with *matter* and its attributes, ſcarcely believe any thing they cannot ſee, and view the purſuits of the Platoniſts with deriſion and contempt: here then is an immenſe gulph between them!!!

The effect experimental enquiries have upon the mind is direct: for although the beauty and ſymmetry of particulars cannot be beheld without believing in a divine artificer, yet when mere matter is ſpeculated without regard to *form*, no connecting link is thought neceſſary to unite it to intelligibles; although it is impoſſible to explain the cauſe of the connection of parts without recurring to an incorporeal medium: the tendency therefore of experimental philoſophy alone is to make its followers Unitarians and Materialiſts. If this be the reſult of ſuch purſuits, they neither deſerve the name, nor can they ever become the real objects of ſcience; and yet a knowledge of *particulars* is abſolutely neceſſary for the improvement of the arts, for relieving the afflictions and ſupplying the comforts of human life. Whenever the nature of particulars is explored ſubſervient to ſuch purpoſes, they deſervedly become objects of general utility and concern; whenever they are explored as the real objects of ſcience, and as the only means by which it can be acquired, a degree of importance is attached to them which they do not poſſeſs, and they are perverted; for the ſcience of wholes will give principles to particulars, but the knowledge of particulars can never give principles to wholes.

If experimental philoſophy is the beſt philoſophy attainable by man, it follows, that the corporeal form of man is the beſt part of his compoſition, becauſe the aptitude of conducting experiments depends principally on organic perfection: but even here we find that ſuch a philoſopher cannot depend on himſelf, but is obliged to employ inſtruments as his auxiliaries, and a variety of changeable materials as the ſubjects of his philoſophy. I ſhould then aſk, what ſcience of aſtronomy does Mr. Herſchel poſſeſs when deprived of his monſtrous teleſcope?

Dr. Prieſtley of electricity, when deprived of his electrical machine? or our beſt experimentaliſt when deprived of his crucible and air-pump?

If theſe inſtruments are found ſo eſſential to the acquiſition of this kind of knowledge, it becomes a queſtion, whether the ſcience does not reſide in the inſtrument rather than the man; for, deprive the man of his inſtrument and you deprive him of his ſcience. If however it be granted, that the ſcience reſides in the organic form of man, and not in the inſtrument he employs, man then becomes placed on a level, if not ſubordinate to the brute.

Bulk for bulk, man ſeems to poſſeſs a middle ſtate when viewed merely as an animal, and when placed in the order of brutes: for although he is greatly ſuperior in ſize to the tadpole, he is very inferior to the elephant. What man is there whoſe eye is equal to that of the hawk or the cat, whoſe arm is ſo ſtrong as that of the lion, or whoſe olfactory organs are ſo acute as thoſe of ſome dogs? If however it be granted that the order of brutes is ſubordinate to the order of man, and that ſcience does not reſide in the organ or in the inſtrument he employs, I ſhould then aſk, ſince there is ſuch a thing as ſcience, where it has its ſeat. Thus then are we compelled to acknowledge an incorporeal eſſence, in which all ſcience * eſſentially reſides.

If

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* The ſcience of geometry affords a very convincing proof that demonſtrative knowledge does not

If it were not for this immaterial principle, man might indeed arraign the juſ-

tice

not depend on inſtruments, and cannot be experimentally acquired; for he would certainly appear ridiculous who ſhould attempt to prove any geometrical propoſition by mechanical meaſurement, although ſuch meaſurement ſhould be performed with the moſt exact inſtruments, and with the greateſt accuracy which human ſkill is capable of exerting.

The axioms on which mathematical knowledge is founded are certain undeniable truths, to which every one muſt give his aſſent. The grounds on which experimental philoſophy is founded are infinite experiments, compoſed of materials that are conſtantly changeable, and can ſeldom if ever be obtained of the ſame quality. The baſis of mathematics therefore is poſitive truth; the baſis of experimental knowledge is grounded on the nature of periſhable materials. Hence it follows, that the ſcience of geometry is immutable, and ever the

ſame:

tice of Providence, and complain of the inequality of its favours; there could be no conteſt between virtue and vice, becauſe the weak would always be ſubordinate and a prey to the ſtrong; organic perfection would be every thing; mental improvement, nothing.

It is far otherwiſe:—Mankind in general, although endowed with different capacities, are alike in one reſpect; they have an internal conſciouſneſs of poſitive good and evil; and there are but few who have not the conſolation of knowing that

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ſame: but the ſcience of experiments is ever variable; and therefore we have had ſince the time of Lord Bacon to the preſent day, an annual circulation of theories upon the very ſame ſubjects, always changeable, never conſtant.

the injuries and ſufferings they experience and endure whilſt attached to natural exiſtence, will be recompenſed hereafter if they have been deſerving of it.

Since then the corporeal parts of man are ſubordinate to the incorporeal, it follows, that intelligibles are the real object of ſcience, and the proper food of an incorporeal eſſence: this is the reſting-place of true philoſophy, the admiration of the wiſe, and the deriſion of the fooliſh. It was this philoſophy that Pythagoras, Socrates, and Plato cultivated with ſuch ardour and ſucceſs in times of old, although the advent of our Saviour, and the divine revelation proclaimed by him and the apoſtles, has interrupted the proſecution of it by the generality of mankind. It notwithſtanding has ever been the ſtudy of the beſt and wiſeſt of our divines.

I ſhall only mention the celebrated names of Doctors Cudworth, Moore, and Norris; of Biſhop Newton, and of that great defender of the Chriſtian faith Dr. Horſley, the preſent Biſhop of Rocheſter, who expreſsly ſays, "*that his* "*philoſophy is Plato's and his creed St.* "*John's* *."

Although the Platonic philoſophy and the Chriſtian religion have both the ſame tendency to purify the mind, and to abſtract it from ſenſual purſuits, there is this important difference between them: the Platonic philoſophy requires previous

knowledge

Does not the Bishop contradict himself in
this paragraph [illegible] [illegible]

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* See the controverſy between him and Doctor Prieſtley.

knowledge and very profound meditation; the Chriſtian religion produces an immediate influence on the mind by means of *faith*: the former therefore can only be the wiſdom of the few; the latter is that of the multitude, and will equally form the conſolation of the wiſeſt and the moſt ignorant of mankind. The Platonic philoſophy is the philoſophy of ſcripture, and the moſt occult parts of St. Paul's epiſtles are beſt underſtood by Chriſtians who have the beſt knowledge of that philoſophy.

Since then it appears that the objects of intellect and of ſenſe are ſo different in their nature, it is evident that they are to be attained by different means. The objects of *intellect* are beſt attained by abſtraction from *ſenſe*, although the objects of ſenſe are beſt underſtood by thoſe who have previouſly ſtudied the philoſophy of intellect. The philoſophy of intellect is *ſcience*, the reſult of the knowledge of ſenſe is *art*; the former has its origin from the operation of mind, the latter from body: hence it follows, that ſcience is better than art. We may therefore conclude with the learned Mr. Harris, "who thinks nothing more abſurd than the common notion of inſtruction; as if ſcience were to be poured into the mind like water in a ciſtern, that paſſively waits to receive all that comes. The growth of knowledge he rather thinks to reſemble the growth of fruit; however external

“ cauſes may in ſome degree co-operate, “ it is the internal vigour and virtue of “ the tree that muſt ripen the juices to “ their juſt maturity.”

Although I do not enter the field of literature with my beaver on clothed in armour, I avoid making any apologies for advancing opinions different from thoſe generally received; no man will be hurt by them if they are wrong, and it is a duty I owe myſelf to avow what I conceive to be right. It were departing from the perſonal dignity every man owes himſelf, otherwiſe I ſhould have concealed my name; I had rather however face danger than fly from it; I only hope that any attacks I may receive may be conducted with candour and liberality;

I am open to conviction, and ſhall be ready to correct the errors it may be proved I have committed.

—astonishing
Candour tho
[illegible]!

I feel as an Engliſhman, and therefore deplore the ſtate of ſcience in this country, when I ſee every one aping the French, by adopting their nomenclature, &c. names as grating to the auditory nerves, as they are unmeaning in their ſignification in the Engliſh language, as *caloric*, *carbonic*, *nitric*, &c. &c. &c. There was a time when it was otherwiſe; there was a time when this envied kingdom was the fountain of knowledge, and imparted ſcience to ſurrounding nations; when Lord Bacon, Sir Iſaac Newton, and a numerous liſt of learned and ſcientific men aſſerted the ſuperiority of this over other countries. What then would they feel if they witneſſed the pre-eminence they obtained, but which their poſterity has loſt! Surely it cannot at this time be aſcribed to an increaſe of wiſdom abroad; it muſt rather be feared that it proceeds from an erroneous ſyſtem of acquiring knowledge at home.

Although I hope to receive candour and indulgence, I ſolicit enquiry and diſcuſſion. The true objects of diſcuſſion are thoſe of philoſophy, and are beſt attained and improved by the exertions of the human mind.

The principles of revealed religion are the true objects of faith, and are beſt attained by thoſe of a pure and uncorrupt diſpoſition.

Human abilities alone are ſufficient to the acquiſition of philoſophical knowledge;

ledge; a ſincere diſpoſition to underſtand the revealed word is one of the leading requiſites to the comprehenſion of it.

This power of the mind is inherent in every man, the high and the low, the rich and the poor; but the poſſeſſion of abilities neceſſary for philoſophical inveſtigation is confined to individuals.

The individuals who poſſeſs, and who have exerted their abilities in ſuch purſuits, have either followed a ſyſtem, ſanctioned by the authority of ſome great name, or erected one of their own; and comparing great men with ſmall, I ſpeak from the time of Lord Bacon to that of Doctor Prieſtley, the principles of the philoſopher have been as it were a revelation to his followers, which all have be-

lieved,

lieved, and few perhaps have thoroughly inveſtigated.

On the contrary, our holy religion, after being fully eſtabliſhed, and our Saviour proved to be the author of it, aſſiſted by men divinely inſpired, has been the conſtant ſource of controverſy and apoſtacy. Can there be a ſtronger inſtance of the corruption of the human mind, or of the perverſion of its purſuits, than that of elevating corrupt and fallible man to the rank of a divine and infallible God? Is it then ſurpriſing that the conſequences are now felt in the country where the atheiſtical genius of Voltaire firſt gave them birth? Muſt we not expect the ſame reſult in this, unleſs the ſyſtem of philoſophy has a different direction given to it?

It has been the atheiſtical philoſophy of the French ariſtocracy that has been one of the exciting cauſes of the deſtruction of the French government. It is the irreligion and the irregularity in the conduct of the moſt part of our own ariſtocracy, that it is to be feared may lead to the ſame calamities, more perhaps than the conquering arms of the enemy.

If I have been ſucceſsful in proving that intelligibles are the real objects of ſcience, it follows, that ſcience is not the object of purſuit of the preſent age. Since the inveſtigation of ſenſible objects by means of experiment is the univerſal practice, it is a natural conſequence of this inverſion of principle that confuſion ſhould enſue. Inſtead of philoſophy being confined to the real objects of ſcience, that ſacred name is proſtituted to the loweſt inveſtigation of material things, and the attributes of mind are totally forgotten in the properties of matter.

It was the loſs of the firſt and of the beſt philoſophy, and the general adoption of the latter and the worſt, that has been one of the remote cauſes of the deſtruction in France of all order and government—"tout homme bien penſant "était un philoſophe:" that is to ſay, every enlightened man had his ſmall cabinet of foſſils and minerals, had a ſmattering of chemiſtry, which was cultivated by the nation at large; and whilſt they were poiſoning their bodies over charcoal fires in making experiments, their ſouls partook of the impurity, and the generality of thinking men amongſt them became materialiſts and atheiſts *.

This country has more to fear from the ſame ſyſtem than it has from the calamities of war; and although I may be laughed at for this kind of language, I am convinced it is founded in truth.

Although I make no apologies for advancing new opinions, I am very conſcious I have not done juſtice to the importance of the ſubject. I was firſt led to reflect on it in conſequence of being preſent laſt December at the Society of Guy's Hoſpital, when the ſubject of Heat was diſcuſſed, and I proſe-

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* I could wiſh to exclude for the moſt part the Provincial Nobility of France.

cuted my ideas during the few minutes I could ſeize from the inceſſant duties of a very laborious and extenſive practice. The conſtant interruptions I have experienced will in ſome degree account for a want of connection in ſome parts, occaſional obſcurity in the ſtyle, and perhaps very glaring miſtakes. Thoſe who know me muſt be convinced that it is a very true, although perhaps a very bad apology.

Newington Butts,
Feb. 17, 1795.

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A DIS-

A
DISSERTATION, &c.

CHAP. I.

THE SYSTEM OF THE WORLD.

THE limited faculties of man can only obtain an idea of the power of God by the inſtrumental cauſes he employs: of his wiſdom, by the regularity and order of the univerſe: of his excellence, by the ſuperiority and beauty of natural productions over the works of art.

Every operation produced by ſuch a Being muſt participate of its cauſe, and reſemble it in a ſubordinate degree: but God being eſſentially one, and of courſe indiviſible, cannot be the immediate and proximate cauſe of thoſe effects that are compoſite and diviſible. An enquiry, therefore, into the firſt proceſſions of the Deity would lead to an inveſtigation of the nature of the Trinity, and of the progreſſion of ſubordinate natures: at preſent I ſhall confine myſelf to the contemplation of the ſenſible univerſe.

The term would ſeem to imply one All, or that which is intrinſically One. As the cauſe of its exiſtence was of a divine and united nature, it follows, that the form of the univerſe muſt participate of unity, and be of the moſt perfect kind: but as a ſphere is the moſt perfect figure that can be deſcribed, it follows that the univerſe muſt be a ſphere, and conſequently that its circumference muſt be equally diſtant from its centre.

Having ſtated theſe principles, it follows, that all the bodies contained within the ſphere participate the moſt of the beautiful, in the ratio of their proximity to the circumference, not only in their figure and motion, but in the uſe for which they are deſtined; and that the body, which forms the centre, is not only the very laſt, and therefore the very worſt; but, if motion be a quality exiſting in the bodies near the circumference, the body at the centre muſt be immoveable. Aſtronomers well know, that either the ſun moves round the earth, or the earth round the ſun: it muſt follow therefore that the ſun moves round the earth;

otherwiſe, that body which is the moſt excellent would be ſituated in the laſt and worſt place.

Such are the ſhort-ſighted powers of man, that it may be doubted whether he can behold the proceſſion of the heavenly bodies near the circumference: the nature of the planets that are nearer to us is better known: although their diſtance from this earth has been calculated and aſcertained, ſuch is the immenſe diſtance of the fixed ſtars that it has eluded all calculation, and yet aſtronomers find them more luminous than the planets that are infinitely nearer to us.

As we cannot analyſe the quality of the matter of which they are compoſed, we can only come to a knowledge of it by aſcertaining what is the cauſe of ſplendor and of darkneſs in other bodies. As all the matter of this globe is eſſentially obſcure, and would be totally inviſible to the eye were it not for the illumination from the ſun; and as thoſe bodies that are the moſt earthy are the moſt dark; it follows, that thoſe that are the moſt luminous are the moſt rare: hence therefore the fixed ſtars are rarer than the planets.

It becomes however a queſtion, whether the celeſtial bodies are all illuminated by the ſame or by different ſuns, or whether they are luminous of themſelves. The ſplendor of a body, abſtracted from the power of the organ of the ſpectator, depends upon the rarity of the medium through which it is beheld, and the quantity of opake matter it contains: if the medium be opake and the body rare, it will appear ſplendid; if the medium be rare and the body opake, it will appear obſcure to the eye; and if we could conceive a body totally deprived of the rays of light, it would be totally inviſible, however proximate, and could only be detected by the ſenſe of touch: it is therefore neceſſary, that the rays of light ſhould be infinitely rarer than other bodies, or thoſe bodies would be totally inviſible. Seeing then that the fixed ſtars and the planets are rarer than this earth, and that it requires conſiderable powers to behold them, we may conclude that this earth is inviſible to their inhabitants; unleſs, indeed, their powers greatly exceed our own.

I ſhall not at preſent inveſtigate the cauſe of the variety in colours, but only obſerve, that this muſt principally depend on the peculiar arrangement of the particles of matter, connected with the medium through which they are ſeen: when, therefore, we look at a body parallel to the earth, however luminous in itſelf, it always loſes ſomething of its brilliancy; but if we aſcend above the ſurface of the thick atmoſphere, it ſhines with nearly its native ſplendor: this may be illuſtrated by looking from the plane at either the riſing or the ſetting ſun, or by aſcending a mountain in the meridian of the day and beholding it. In the day, during the ſun's preſence, ſuch is the quantity of light filling the upper regions, that the planets and the other bodies are relatively opake, and cannot conſequently be ſeen; but at night, when the medium is obſcure, ſuch is the natural brilliancy of theſe bodies, that they become the objects of ſight, although the ſun no longer exerts its influence in that part; they therefore become ſuns at night, in a ſecondary manner, as much as the ſun itſelf is the principal cauſe of light in the day.

As we have conſidered this globe, becauſe the moſt opake, as the centre of the univerſe, it follows, that thoſe bodies that are nearer the circumference muſt be the moſt rare, and therefore the moſt luminous; this therefore accounts for the brilliancy of the fixed ſtars, for the relative opacity of the moon, and for the irregularity of its appearance; for being the moſt proximate to the earth, it muſt be much purer and better formed than it; although more opake and more deformed than either the planets or the fixed ſtars that are farther removed from the centre.

If the motions of the heavenly bodies be examined, it will alſo be found that the moſt perfect motions take place near the circumference, becoming more complicated and imperfect, until they are perfectly loſt in the centre, which being compoſed of matter imbecil and inert, has no power of motion, and therefore remains unalterably fixed.

CHAP. II.

If then this terreſtrial globe be the laſt proceſſion of the univerſe, may we not alſo conclude, that it contains the laſt proceſſion of animated natures; that man is here born in ſin, and that the planets and the other heavenly bodies are the ſeat of juſt men made perfect; of thoſe who have lived in unity of ſpirit, in the bond of peace, and in righteouſneſs of life; that the ſoul, no longer fettered by the body, is freed from its paſſions, and energizes according to its own divine nature;

that the life of man on earth is a life of warfare, and a conteſt between ſoul and body; that thoſe who live according to the paſſions become unfitted to enjoy a purer ſtate, and therefore continue attached to body; but that thoſe who make the body merely the inſtrument of the ſoul, are releaſed from a ſepulchre as it were when the death of the body produces a liberation of the ſoul; that the ſoul aſcends on high with its ethereal vehicle, and continues for ever bleſſed?

Such is the ſubtle nature of incorporeals that they can never become the objects of ſenſe, and can be apprehended by pure intellect alone: to thoſe, therefore, who are immerſed in matter and experiments they can ſcarcely ever become the ſubject of ſpeculation: ſuch men, by devoting themſelves to organic powers, have abandoned thoſe of ſoul, and are unacquainted with the media that unite it to body. It is a proof of its native tranſcendency, and no argument for its non-exiſtence, that ſuch men ſhould be ignorant of its nature.

It is ſcarcely neceſſary for me to prove the exiſtence of an immaterial and conſequently of an immortal ſoul in a corporeal nature; thoſe who are ſo unhappy to require ſuch proof, will I hope have grace given them to apprehend it by faith in revelation: let them conſult the works of Plato, particularly the elegant tranſlation of the Phædo, by the ingenious and learned Mr. Taylor, amongſt the ancients; and of Baxter and Dr. Clark, amongſt the moderns: if they be not convinced by theſe authors, they muſt deplore their own imperfection, and not the truth of the thing itſelf. In pity to ſuch I ſhall however offer to their conſideration the following demonſtrative arguments for the immortality of the ſoul: In the firſt place, the ſoul is a ſimple eſſence, void of parts, for if it contained parts it muſt alſo be diviſible; but that which is diviſible is diſſoluble, that which is diſſoluble is a compoſite, that which is a compoſite has triple dimenſions, and that which has triple dimenſions is body; but body when conjoined with body produces an increaſe of bulk. It is however evident, that ſoul which is in body does not produce an increaſe of bulk, but rather vivifies body; ſoul therefore is not body, but incorporeal. Again, if ſoul is corporeal, it muſt alſo have ſenſible qualities, and be nouriſhed in a corporeal manner; but it is nouriſhed in an incorporeal manner, for its nutriment is derived from reaſon. It has not therefore any ſenſible qualities; for neither juſtice, nor fortitude, nor any thing elſe of this kind can be ſeen, and theſe are the qualities of ſoul; ſoul therefore is not body, but ſomething incorporeal. But if it be ſimple or without parts, it is alſo indeſtructible and immortal; for diſſolution ariſes from the ſeparation of one part of a thing from another, and this can never take place in a ſimple eſſence.

We have alſo demonſtrative evidence that every part of the human body is undergoing a perpetual change, and the experiments made on different animals ſeem to prove that in the courſe of ſeven years a total change has taken place; ſo that no part of my body that now exiſts formed any part of its compoſition ſeven years ago. If then the attributes of mind depend on organization, and body be the recipient, it is impoſſible that any permanent ideas of things can exiſt, for they can never ſurvive the duration of the organ that received them; and as new particles are depoſited as the old are abſorbed and carried away, it follows, that we could have only half an idea of any thing, and that for a very ſhort time. Memory therefore can form no part of ſuch a ſyſtem; for as no effect can ſurvive its cauſe, and as the cauſe does not exceed the limits of ſeven years, the recollection of paſt events cannot extend beyond this period.

Caſes have occurred where patients, either in conſequence of accidents or of diſeaſes, have forgotten the events of the latter parts of their life, and recollected what happened to them in their youth. A curious inſtance of this nature happened to a man who was brought to St. Thomas's hoſpital with a concuſſion of the brain. By proper treatment he recovered; but it was obſerved, that though he converſed with the attendants, it was in a language which none of them underſtood. A Welch milk-woman coming into the ward, and hearing him ſpeak, entered into converſation with him—it was then found that he was by birth a Welchman, but had left his country during his youth, and had entirely forgotten his native tongue. In the courſe of thirty years which he had lived in England he ſpoke the Engliſh language alone: ſince the accident he had received he only remembered the events of his younger years, which he had entirely forgotten before he received the injury in his head; but the Engliſh language and the occurrences of the latter years of his life he had totally forgotten.

With a view of ſhewing the ſuperior influence of the mind over the body, I ſhall alſo relate the well-known ſtory of the ſon of Crœſus, who was born dumb. Seeing his father on the point of being ſlain in action by an adverſe ſoldier, he at once exclaimed, Oh ſoldier, ſpare Crœſus!

It may however be queſtioned by ſome,

whether it be the organs of the body that give the ſoul its character, or rather the ſoul that ſtamps the body, not only with its form, but becomes the cauſe of its various operations.

It was the opinion of the ancients, that all animated natures on earth were nothing more than the dark ſhadows of certain *forms* exiſting in the intelligible world, and that it was the diſtinct nature of theſe forms that gave the diſtinguiſhing characteriſtics to all animated bodies, of which they were the exemplars, and that the bodies were only modelled according to their peculiar nature.

We may perhaps gain a glimpſe of the nature of theſe forms, by reflecting on the various operations of the mind when it employs the body in fabricating any thing. When an architect contemplates the model of a palace, and puts the deſign on paper, the form of the palace had a prior mental exiſtence in an immaterial manner, and the deſign on the paper is nothing more than the image of that which before exiſted in his mind. When a man commits his thoughts to writing, the letters are nothing more than the pictures expreſſive of thoſe formed in the mind; but as every cauſe is better than its effect, mental conceptions muſt neceſſarily tranſcend corporeal operations, and the body can never perfectly execute the conceptions of the mind: theſe conceptions are as infinitely ſuperior to the organs as the hand of the artiſt is to the pencil it employs;

but as the knowledge of man has a twofold origin, and unhappily uſes the external organs more than the internal, it is neceſſary that the external organs ſhould be adapted to the various bodies with which man is continually ſurrounded: hence therefore the utility of the five ſenſes.

It is neceſſary to obſerve, that theſe organs have only the capacity of action, but do not poſſeſs action itſelf independent of the operation of either internal or external cauſes: the internal are thoſe of mind; the external are referable to one general head, that of producing ſenſation; but that the perfect action of each particular organ be produced, it is neceſſary that the ſtimulus be of a diſtinct nature; for although all the organs are ſuſceptible of ſenſation, each organ requires its own peculiar ſtimulus: for example, the rays of light for the eye, vibratory motions of the air for the ear, &c. But as the organization in each is different, that ſtimulus that produces ſound to the ear will not produce illumination to the eye, and *vice verſa.*

Although theſe impreſſions on the organs are various and limited, yet the ultimate effect produced and communicated through them to the mind is univerſal, conſiſting of an aggregation of the total ſenſation of every organ. The eye can only ſee, and the ear hear, or rather the life diſtributed in the organ; each organ therefore can only have a partial knowledge of any ſubject, ſince that knowledge cannot extend the limits of its organization. But the mind that pervades all the organs in an united manner, as a *whole* and an *univerſal*, receives the impreſſions from each according to its own nature; it receives things diviſible according to an indiviſible energy; things partible, impartibly; things temporal, eternally, &c.

It may therefore be concluded, that the organs diſtinguiſh the *particular* nature of a body, but that the mind receives and conceives theſe particulars wholly and univerſally: when therefore the organs of the body receive impreſſions *ab externo*, theſe impreſſions are conceived by the mind in an aſſimilated manner, correſpondent to the nature of the objects: when the organs are defective or diſeaſed, theſe impreſſions are communicated through a bad medium, and therefore produce imperfect information: or if the mind be diſeaſed and the organs ſound, unreal impreſſions muſt be the reſult: this I conceive to be the caſe with moſt maniacs; for although their organs are healthy, yet the recipient being diſeaſed, unnatural ideas of real things muſt be the conſequence.

It may therefore be concluded, that as every thing fabricated by man had a prior exiſtence in his mind, ſo every thing beheld and underſtood by the ſpectator is apprehended by an image formed in the mind, correſpondent to the ſubject, ſimilar to a ſhadow from its forming ſubſtance.

If we purſue this reaſoning from artificial to natural productions, we ſhall find that it equally applies; but as the powers of nature infinitely tranſcend the powers of man, it follows, that the operations of the firſt are infinitely more excellent, more regular, and more various than thoſe of the latter. Nature therefore may be ſaid to contain thoſe *forms* of which the various ſenſible productions of nature are merely ſhadows; it is the peculiar quality of theſe immaterial and natural forms that ſtamps the character of every natural ſubſtance; they muſt be definite in their nature, becauſe the bodies that contain them are limited by a certain order and arrangement; it is the peculiar characteriſtic of them that prevents the body from growing to infinite magnitude after it has attained the ſize this natural form has given it, although the cauſes of its perpetual growth continue to be applied; it is this that faſhions the various parts, and becomes the cauſe of their various operations; it is this that, exiſting in ever-vital energy, is able to communicate a generative power to certain parts; and this it is that may be truly called the *vis medicatrix et conſervatrix naturæ*.

Inſtead of aſcribing the phenomena of life to this principle, it has been the faſhion of late to aſcribe them to organization alone: but as all the organized parts, after being firſt formed, aroſe from the ſecretions, the ſecretions from the blood, and the blood itſelf is not organized, as it is always undergoing mutation from its circulation; it muſt follow, that this principle is totally diſtinct from mere organization. It is generally admitted, that the food, after having undergone the proceſs of digeſtion and chylification, is then alone fitted for ſecretion, and is endued with the principle of life. The aliment taken in ſeems as much the food of the blood, as the blood itſelf is the food of the ſecretions; for as no blood can be formed without aliment, ſo no ſecretion can be formed without blood.

Secretion is that proceſs by which fluids are ſeparated from the maſs of blood, for particular purpoſes. Nature ſeems to have been remarkably careful, that the blood deſtined for the purpoſe of producing or repairing parts, ſhould have completely undergone this aſſimilated proceſs, and been endued with the vital power.

As the blood in an unorganized ſtate poſſeſſes this principle, and as all organized parts are formed from vital blood, it follows, that the principle of life exiſted prior to organization, and that the deſtruction of the organization does not cauſe a deſtruction of life. Organization is deſtined to diſplay the phenomena of life, as life itſelf unfolds thoſe of organization. Life, therefore, ſeems to be an higher and a prior principle to either the phenomena or the organization.

May we not then conclude, that life is an immaterial principle; that the corporeal parts of man, animals, and vegetables are nothing more than the inſtruments ſubordinate to this principle; that it conſtitutes what may be called the natural power; and that it continues to ſubſiſt, although the body be deſtroyed?

The animated ſyſtem may therefore be called a ſyſtem of matter, flowing from this principle, giving the body a capacity of receiving impreſſion, the reſult of which is ſenſation and motion: without this property it would be dead and inert matter; but poſſeſſed of this principle, it becomes living matter, and is called into action.

When the ſtimuli act with ſufficient power on this principle, then the agreeable ſenſation of health is felt; but when the exciting powers are either ſuperfluous or defective, then diſeaſe takes place; and when they ceaſe to act, or the ſyſtem to feel their influence, then death enſues.

It is by inveſtigating the nature of this principle, acting as a cauſe, that the phenomena of life, of motion, and of health will be known; it extends the ſame laws to the whole range of animated exiſtence; and if the ſources of health and of ſtrength are aſcertained, a more perfect knowledge of weakneſs and diſeaſe will be known; for although the cauſes of diſeaſe are infinite, the ſtandard of health is ſingle and alone: for the phenomena of life flow from the properties of this living matter, and health and diſeaſe from its various ſtates.

If the organic form of man, animals, and plants be examined, a regular proceſſion of media will be found to connect the ſenſations received by the organs to their progreſſive impreſſion on the mind;

and although all phyſiologiſts agree that the nerves are the agents, ſuch is the delicacy of their ſtructure, that the manner how this effect is produced has eluded every inveſtigation.

We know that although actio ncannot exiſt without life, yet life may exiſt without action; for it has been aſcertained that the vital principle ſubſiſts equally in a freſh egg as in the chick. In the egg it lay in dormant capacity, until called forth into energy by incubation. Incubation produced an evolution of the organs, until the period was elapſed deſtined and limited by nature for their perfection, for the purpoſe of diſplaying the phenomena of life *.

There

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* With a view of ſhewing the importance of this living

There is allotted a certain quantity of this principle to every living ſyſtem; it differs however in each, and it is not improbable that it may occaſionally be increaſed or diminiſhed in the ſame ſyſtem, ſo far as regards the corporeal

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living principle in generated natures, I ſhall briefly ſtate ſome experiments made by Mr. John Hunter.

1. He expoſed to a freezing atmoſphere eggs that were in a ſtate of putrefaction, by being long kept, and others that had been new laid; he found that the firſt froze ſeven minutes before the laſt.

2. He placed eggs that had been new-laid, and others that had been long kept, and expoſed them to a certain degree of heat, and it was found that the freſh eggs were much longer in running into putrefaction than the others; from whence it follows, that a freſh egg has the power inherent in it of reſiſting cold, heat, and to a certain degree putrefaction alſo.

organs. It however becomes a queſtion, whether the whole quantum of this power is given to generated nature *a principio*, and from its tranſcendent excellence becomes, like an inexhauſtible fountain, capable of imparting power to the organs during their evolutions? or whether it acquires additional ſtrength with organic perfection? I ſuſpect it receives it totally and at once; for, as I conceive it to be indeſtructible in its nature, I do not ſee how any external cauſe can either limit its eternity—perfect or debaſe its nature.

It is far different with the corporeal organs: they are not only indigent of this power, and cauſed by it, but they depend alſo for their duration on the continual operation of material and immaterial. The material cauſes are, heat, light, ſound, air, motion, and the ingeſta, &c.; and the immaterial are, the powers of the mind. *Animal* life therefore may be ſaid to be a forced ſtate, having an unceaſing tendency to diſſolution, which is only oppoſed by the inceſſant application of external and internal powers.

When the external ſtimuli become more powerful than the internal powers, inſtead of the principle of life preſerving the dominion over the organs, the external ſtimuli, by their power and continued application, convert the organs to their own nature, and corporeal life ceaſes to exiſt.

It ſeems that this vital principle pervades all animated creation: plants have this vegetative power alone; brutes, the vegetative and the ſenſitive; but man has the vegetative, the ſenſitive, and the intellective: it therefore becomes neceſſary to mark the diſtinguiſhing characteriſtics between living animal and vegetable matter, from that which is inanimate and common; the peculiarities of the former from the latter; thoſe that are common to both; and laſtly, thoſe that are peculiar to man.

CHAP. III.

ANALOGY BETWEEN ANIMALS, VEGETABLES, AND MINERALS.

MATTER has in general been divided into animal, vegetable, and mineral; and although there is a great difference between the extremes, the proceſſion is ſo regular that it will be found very difficult to ſay where animal matter ends, and vegetable begins; or where the moſt imperfect of the vegetable is loſt in the moſt perfect of the mineral world: the diſtinction and change are ſo regularly preſerved and gradually continued, that each ſeparate kingdom ſeems to belong to one great chain, whoſe particular parts are loſt in its ſeparate links. We have reaſon, however, to think that we can diſcover animals and vegetables from foſſils on the one hand, better than give the diſtinguiſhing characteriſtics of the animal from the vegetable world.

Foſſils are deſtitute of the properties that animated natures poſſeſs; they are deſtitute of the principle of life, of organization, the power of procreation, and of growth.

Animals and vegetables poſſeſs theſe different attributes—increaſe from within; outwardly, they are capable of performing various operations; of reſtoring parts that have been deſtroyed, although at laſt they wither and die, and are loſt in the common maſs of matter.

But minerals poſſeſs no internal powers; they only increaſe in ſize by accretion from without; their organization, if it can be ſo called, can only be effected by violence or chemical decompoſition; and if one part be deſtroyed, they poſſeſs no power for its reſtoration.

In tracing the analogy between animals and vegetables, we ſhall find it very great; and although the manner of their production may be different, they ſeem to be governed by the ſame laws. We ſee ſome plants that are affected by the ſame objects that impreſs changes on the animal machine. Light admitted to plants makes them expand and blow, whilſt darkneſs cauſes them to ſleep: the ſame thing happens to animals. Both ſuffer from the intemperance of climate;

both are ſubject to be exhauſted by heat, and to be frozen by cold; both ſuffer from hunger and thirſt; and although animals have organs of apprehenſion by which they lay hold of their food, yet we frequently diſcover that the roots of plants turn aſide from a vein of bad earth in ſearch of a better ſoil. We therefore find both to pine and decay from inanition—both to be too luxuriant from repletion—both to be diſeaſed from læſion and amputation of their limbs—both to be deſtroyed by the deſtruction of their organization—and both to die of old age.

It may then be aſked, in what conſiſts the difference? Volition, connected with a loco-motive faculty, is ſaid to be ſufficient to diſtinguiſh the animal from the vegetable tribe; but there are animals

mals that ſeem deſtitute of any loco-motive power, ſuch as oyſters and other ſhell-fiſh: and on the other hand, ſome plants to which it belongs. The leaſt impreſſion from the touch will put the ſenſitive plant in motion, and it is ſaid that the Dionæa Muſcipula often takes flies priſoners by a contraction of its leaves; to which it may be added, the power of vegetables to experience pleaſure and pain has even been attempted to be proved.

If the perception of man be compared with the perception of other animals, the chaſm will be found infinitely greater than between the laſt and ſome of the vegetable tribe; for the motion of many plants is as definite, and as much guided by intelligence, as the motion of many animals. The ſun-flower, that follows during the day the regular courſe of the ſun, ſhews as much deſire to reap benefit from its rays, as the oyſter does in opening its ſhell at the afflux of the tide.

There is one mark of diſtinction mentioned by Mr. Hunter—he ſays that vegetables have no ſtomachs; but if we reflect on the ſtructure of ſome animals, we ſhall find them deſtitute of that organ, as Dr. Monro has proved of the tænia, for its aorta ariſes from, and is as it were a continuation of the mouth. Finally, if we compare the moſt perfect of one claſs with the moſt imperfect of the other, or even the extremes of the ſame claſs, we ſhall find the difference to be immenſe; but if we trace the moſt imperfect of the one with the moſt perfect of the other, the moſt perfect mineral with the moſt imperfect vegetable, we ſhall be at a loſs to ſay to what link it belongs, as the difference is infinitely progreſſive and ultimately loſt.

I recollect to have heard the late Mr. Hunter ſay, that he ſuſpected man was originally black, and that it was only by the infinite progreſſion of time that he degenerated and became white. He drew his opinion from analogy, by obſerving that the moſt perfect ſpecies of moſt animals were black, and that the individuals of that claſs were degenerate in the ratio of their ſimilitude to white: he inſtanced black cattle, turkies, and an infinite number of animals, whoſe perfect ſpecies were black, although the individuals were now of various colours. No one has an higher veneration for the memory of that great anatomiſt than myſelf; but I cannot help thinking that he took the matter at the wrong end, and I conceive that the analogy he drew led to a directly oppoſite concluſion. For as man is at the head of terreſtrial animals, and as there is a regular proceſſion from him to the laſt ſpecies of matter, it follows, that the moſt perfect man ought to be white, the moſt imperfect black; and the moſt perfect of the next claſs of the ſame colour, for the purpoſe of preſerving the regularity in the order of nature. It is alſo neceſſary that the faculties of the mind ſhould accord with the degenerate form of the body on the one hand, and that the moſt perfect animal of the firſt claſs ſhould have the power of reſembling, although in a ſubordinate degree, the mental conception

ception of the laſt order of man. This I underſtand correſponds with the opinion of thoſe naturaliſts who have ſtudied the faculties of the negroes; and I am informed that their capacity to receive inſtruction ſeems to diminiſh in proportion as they become perfectly black *.

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* No one who knows me will from thence conclude that I am a friend to the ſlave trade, or wiſh to treat the blacks as animals:—they poſſeſs the ſame nature as ourſelves, and therefore are entitled to the ſame humanity, and from the imbecility of their abilities have a greater claim on our attention.

CHAP. IV.

ON ATTRACTION IN GENERAL, AND OF COHESION AND ELECTION IN PARTICULAR.

IT has been the error of philoſophers in inveſtigating the laws of the univerſe to attend to particulars inſtead of univerſals; and becauſe Sir Iſaac Newton ſaw an apple fall from a tree, he concluded that the earth poſſeſſed the principle of attraction. The ſyſtem of the world is not to be thus ſtudied; the laws that govern the action of particulars can only be diſcovered by acquiring a knowledge of univerſals; and if we can attain theſe, the principles of particulars muſt follow *. *Plato ſays, that a philoſopher ſhould never meddle with any thing but wholes, or things common.*

The ſyſtem of nature is a ſyſtem founded on ſymmetry and order, and governed by general laws: theſe laws are all ſubſervient to the preſervation of this œconomy, and the objects dependent on this œconomy are the elements: theſe elements proceed from the moſt excellent and rare, to the moſt indigent and ſolid.

Although the different elements are at preſent combined and united, there can

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[*] For the doctrine of wholes, which forms the moſt important part of the Platonic philoſophy, ſee Mr. Taylor's Introduction to the Timæus of Plato.

be no doubt that the combination of particulars has a reference to the original elements from which they proceed: that theſe elements are *wholes*, with reſpect to *parts*; and that the principle that governs theſe parts has for its object the preſervation of the order and gradation of the whole.

So far therefore from the earth poſſeſſing the principle of attraction, it will be found that there are a variety of bodies that have a conſtant tendency to fly from its ſurface, ariſing from the natural diſpoſition of all parts to return to their original elements after the end is accompliſhed for which they were ſeparated: this is the reaſon why ſolids fall to the earth, why all rivers flow into the ocean, and why airs are permanently elaſtic, having a conſtant diſpoſition to aſcend.

The general fact is obvious, that the particles of matter are united together, and out of this general fact particular ones ariſe as varieties of this general fact: thus we find ſolids (as it is ſaid) attracted by the earth to which they are fixed; fluids diſſolving ſolids, and airs uniting with both: theſe various peculiarities have been diſtinguiſhed by chemiſts by particular names, as thoſe of coheſion, election, gravitation, &c.

The union produced in bodies by each particular kind of attraction is found to vary according to the peculiar nature of each of the elements of thoſe bodies: thus we find, that two ſolids of the ſame quality do not unite by means of elective attraction; the ſame may be ſaid of fluids of the ſame nature, as well as of air. The fact is eaſily aſcertained; as each of theſe bodies, when conjoined, retains its original and individual properties: thus, two pieces of earth or two ounces of water added together will only produce an addition of bulk, but no difference in their qualities; and, as this is accompliſhed by external force, it has nothing to do with what is called attraction, for attraction means an inherent power or diſpoſition that all bodies have to unite: hence it follows that homogeneous bodies have no elective attraction for each other.

CHAP. V.

OF THE ATTRACTION OF COHESION.

A QUESTION naturally ariſes as to the cauſe of this union of matter itſelf, that is, of the attraction of coheſion. It is a common opinion that it proceeds from the attracting power of matter itſelf, aided perhaps by ſome intermediate fluid of a very rare kind; but this is attributing life to matter which is dead, and confounding the whole order of things, from what exiſts in ever vital energy to that which is immoveable of itſelf and void of life.

It is an acknowledged fact, that every ſyſtem of matter conſiſts of a number of particles, which particles are diſtinct and ſeparate from each other; and if theſe particles are removed to a certain diſtance, the bond of union is deſtroyed, and a ſeparation of them takes place.

It is well known that the dimenſions of bodies are diminiſhed by ignition: it follows therefore, that the particles of bodies are not in contact with each other; for if they were in contact they could not approach nearer to each other; and this would be the inevitable conſequence of their contraction of bulk, unleſs indeed the ſame bodies penetrated each other: but if this were admitted, the conſequence would be, that two bodies could exiſt in the ſame place at one and the ſame time: nature abhors this, and reaſon and experience oppoſe it.

The ſame conſequences would enſue from ſuppoſing the individual particles themſelves to become contracted.

What is it then, I aſk, that connects and holds together the parts of bodies? It cannot be any thing corporeal, ſince, in this caſe, the above abſurdity would enſue. Body muſt therefore be the recipient of certain incorporeal powers, which however by their union with body are corporaliſed in a moſt eminent degree: hence they retain but a faint veſtige of immateriality, are full of material imperfection, and may be ſaid to be *corporeally incorporeal.*

real. The phenomena of gravity, levity, and the other qualities of body, are owing to theſe powers, which are the bonds of its elementary parts, and therefore the cauſe of the *attraction of coheſion.*

It may perhaps be doubted by ſome, whether the elements ever exiſted in a pure and ſeparate ſtate, ſince all the light we now behold is nothing more than the rays emanating from the ſun, which cannot be collected on the earth pure and abſtracted from foreign matter.

A queſtion therefore ariſes, whether it be not legitimate to make the ſame concluſions reſpecting water and earth, and whether the whole of this globe be not the very dregs of elements exiſting in the celeſtial regions; for I am perſuaded that the ſun itſelf infinitely tranſcends its participated rays, as they are infinitely purer, individually, than combined.

It is an eſſential property of every original element to tranſcend the nature of its effect; for this is the property of every primary cauſe. Pure light therefore, being the cauſe of colour, is in itſelf void of colour: were the rays endowed with any particular colour, that colour would be imparted to the object, and thus a falſe medium would be produced.

If pure water poſſeſſed taſte, inſtead of fluidity, it would give its nature to every body to which it was a baſe; and if matter were figure, it could not be the ſubject for all figures; but poſſeſſing *capacity* alone, it becomes a fit recipient for all images: ſuch, I believe, were the individual properties of the different elements in their pure and uncombined ſtate.

CHAP. VI.

ON ELECTIVE ATTRACTION.

AS all multitude ariſes from unity, ſo perfection muſt precede imperfection, as the firſt is the ſource of the laſt: it follows therefore that the original elements are the moſt excellent, and that the various combinations we now find in each are impurities united with what is in its eſſence originally pure: thus we find a great variety of airs becoming progreſſively more impure in the ratio of their diſſimilitude to pure air; and if clay be the original element of earth, then all earthy bodies are more or leſs pure in proportion to the quantity of clay which they contain.

It may indeed be aſked, whether there ever was this original variety in each element: it ſeems probable there was not; for, as I before obſerved, the imperfect can only ariſe out of the perfect; before the various gaſes were formed, the moſt perfect gas muſt have exiſted. We may therefore conclude that the different elements had a ſeparate exiſtence, and that the great variety in them we now behold, ariſes from the junction of oppoſite elements, or the mixture of their various combinations.

The original elements therefore are homogeneous bodies preſerving a certain relation to each other, which relation permits the mutual union of each proximate element without violence: thus we find light and air, air and water, water and earth, all ſeparately uniting with amicable conjunction; but whenever the extremes unite by the diſpoſſeſſion of the proximate, violence is the conſequence; and as the relation of the elements proceeds from the moſt rare to the moſt ſolid, light ſtands as the firſt element, and earth as the laſt.

If then it be true that theſe original elements have no other relation to each other than that of proximity, and produce no other effect than that of occupying ſpace, whilſt each element preſerves its proper rank; it follows that the principle called attraction is not a principle eſſential to the element of matter in a ſtate of order and ſubordination; and as the elementary nature of matter is its moſt perfect form, and combination without violence is natural to it, hence it follows, that whenever a mixture of the different elements takes place, that it is an unnatural act, and that the ſtrongeſt junction can only take place between oppoſite elements or their various impure combinations: the doctrine therefore of elective attraction is founded on the oppoſite nature of bodies, and not on the ſimilitude they bear to each other.

Having eſtabliſhed theſe principles, it is the duty of the chemiſt to analyſe the quality and diſcover the contrariety of bodies, and to find out the degree and ſtrength of combination that will enſue. The union of various airs and of earthy ſubſtances, and the conſtant change that is taking place both in animate and inanimate bodies, will afford an infinite variety in the quality of the ſubſtances we ſee. It may however be laid down as a law, that the elements had a ſeparate exiſtence; that combination of *parts* implies confuſion with regard to *wholes*; and that this combination will be the ſtrongeſt between the parts of the extreme elements; between the moſt perfect of the one, and the moſt imperfect of the other.

The principle of chemical attraction, as it is improperly called, depends on the contrariety of oppoſite and extreme elements; and the degree of purity of one element with the degree of impurity of another, is the law by which it is governed.

Muſt it not then follow, without making the experiment, that pure air and impure air, when joined, will explode; that combuſtion will take place between pure air and ſteel; and that the quantity of light and of pure air contained in ſalt-petre, when united with charcoal and ſulphur, will detonate on the application of a ſpark?

As water is the intermediate element between air and earth, each will preſerve its own identity when united: this is the reaſon why pure earths are inſoluble in pure water alone, but become ſoluble by impregnating water with air. The neceſſity of this principle of *contrariety* is ſtrongly illuſtrated in this very inſtance; for it requires the union of fixed air with water, as it is that which is fartheſt removed from the nature of earths, and pure air is too ſimilar to pure water to poſſeſs this ſolvent property.

As metallic bodies are the next proceſſion of earths, it is not ſurpriſing that pure water has not a ſolvent power over them, although they are corroded and deſtroyed by air, the next element that is fartheſt removed from water; and if the pure ſolar rays could be brought into immediate contact with pure ſteel, the moſt violent fire would take place *.

Although

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* I have never made the experiment, neither is it poſſible to do it perfectly, becauſe the rays of the ſun, totally uncombined, cannot be obtained; it is however expreſsly mentioned in the laſt edition of the Encyclopædia Britannica, that the pure *ſolar rays* in

Although water cannot diſſolve metals, owing to their ſimilitude to earths, it is not ſurpriſing that ſalts are liquefied by water, becauſe they are fartheſt removed from earths, their original elements; they therefore become ſufficiently diſſimilar to water, to be acted upon by it: and ſugar and other ſaline bodies, produced in conſequence of vegetation, ſubſiſting in the laſt order of earthy bodies, will be very powerfully acted upon by water: hence it follows, that the purer ſalts are, the more readily they will diſſolve; and that earthy bodies combined with ſugar or with ſalts will impede their ſolution.

On this principle it is that liquids diſ-

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vacuo produce the moſt intenſe fires. And every chemiſt knows, that if a piece of ſteel be introduced in a bottle full of pure air, a moſt vivid fire is produced on the application of a ſpark until the whole is conſumed.

ſolve ſolids, or ſolids combine with liquids: it is uſual to aſcribe the whole power to the fluid, whereas the ſolid has as great a tendency to convert the fluid to a ſolid, as the fluid has to change the ſolid to a fluid form. Solution, therefore, I conceive to be an act of violence, ariſing from the oppoſition of bodies, and not from the attraction they bear each other. The act of ſolution is exactly correſpondent to the phenomenon of combuſtion, ariſing from the ſame principle, and regulated by the ſame laws.

Since it appears then, that fluids for the moſt part convert ſolids to their own nature, but that ſolids have ſeldom if ever this power over fluids, it follows, that fluids are more powerful in their nature than ſolids, and this ariſes from the ſuperior rank they hold in the proceſſion of the elements. On theſe principles, I conceive, may be explained the particular ſolvent properties of various acids, &c. &c. with different kinds of earths, ſalts, &c. &c. of which the induſtry of the experimentaliſt furniſhes ſuch an abundant ſtore in his laboratory.

It may indeed be aſked, what is the cauſe of this violence in all natural bodies? I would anſwer, that it flows from the protecting hand of Nature, always vigilant in preſerving the order of the univerſe, and is that which conſtitutes the *vis inſita* of parts *, by which they poſſeſs a conſtant diſpoſition of converting bodies diſſimilar to themſelves to their own nature; and when they fail in this, it is accompliſhed by that element which predominates vanquiſhing as it were the more imbecil. Solids, therefore, being ſubordinate to fluids, are diſſolved by them; whilſt the matter of light, of heat, and of air has the ſuperior power of acting upon all, and converting ſolids, and even fluids, to its own nature, until the end is accompliſhed for which the final cauſes of things ever exiſted. Whenever that period is attained, a period limited by Nature, of which ſhe is the guide, then diſſolution takes place. This is accompliſhed by fermentation, a proceſs by which the component parts of a body are ſo far ſeparated and changed as to continue unfit for its ſupport; and

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* Natura reſpuit, ut contraria quæque jungantur.
BOETH.

I think it probable that the parts of which that body was compoſed, being diſqualified for vitality, return to their original elements, by which they become aſſimilated, and again rendered fit for the purpoſe of contributing to the ſupport of either animal or vegetable exiſtence.

Dr. Prieſtley has proved the purifying power of vegetables in meliorating bad air. I do not however think it a ſufficient ſource of correcting the corruption that is continually going on; there ſeems to me a neceſſity of recurring to the conſtant diſpoſition there is in parts of returning to their *wholes*, by which they undergo the neceſſary melioration. It is probable that the province of purifying air is allotted to vegetables alone; but this will not account for the amendment of either fluids or ſolids that have undergone a putrid form, unleſs we allow that water and earth have this power alſo. I would aſk, whether the neceſſity of ſea-water does not ariſe from this cauſe; for the purpoſe of the ſaline matter of which it is compoſed uniting with the impure bodies that flow into its boſom, by which they are decompoſed, and again rendered fit to be the inſtruments for the final cauſes of things, and be ſubſervient to the end for which things were created?

The phenomenon of the Mediterranean ſea is a ſtrong illuſtration of theſe general principles: the ocean is not only flowing into it with great rapidity through the Straits of Gibraltar, but a number of the largeſt rivers in Europe, Aſia, and Africa are perpetually diſcharging alſo the whole of their contents. It was for a long time a matter of ſurpriſe, why, ſince there was no outlet for this conſtant increaſe, an inundation of the ſurrounding country ſhould not have happened. A knowledge of the evaporation that is conſtantly going on from the ſurface of the ſea removed this difficulty.

The quantity of this evaporation in warm countries ſurpaſſes the conception of thoſe who have not had an opportunity of knowing the fact: even in our own country, the Biſhop of Landaff found that in the month of July the evaporation from one ſquare acre of land gave two thouſand eight hundred gallons of water in twelve hours time, where there had been no rain for a week.

What then muſt it be from the ſurface

of the ſea in the warm climate of the Mediterranean ? And as this evaporation is continually taking place, to ſuch a degree that the water of the rivers and of the ſea united are alone ſufficient to preſerve the proper level, we may conclude, that if there was not an influx of the rivers, the ſea would be inadequate to the ſupply; and as the evaporation of the aqueous parts is continually going on, the whole Mediterranean would be found a maſs of ſalt: the rivers, therefore, are one of the cauſes of the preſervation of the Mediterranean ſea.

But as theſe rivers are continually carrying into it materials that have periſhed, in a ſtate of putrefaction and decay, it follows, that if the Mediterranean were ſupplied with freſh water alone, by the omiſſion or abſtraction of the ſea, it would have been a putrid marſh or lake; for the water of all rivers is freſh, and does not poſſeſs a purifying power, but becomes itſelf putrid by the admixture of decayed materials: if therefore it were the property of rivers to ſtagnate inſtead of flowing, and if the recipient were of the ſame nature as themſelves, putrefaction muſt generally prevail: hence the neceſſity of ſea-water; and it follows, that nature muſt either admit a perpetual influx of the ſea, or intend that the whole ſhould periſh.

If there was a reflux of the ſea through the Gut of Gibraltar, as much ſea-water perhaps would be carried by the reflux as was introduced by the afflux of the tide; and thus no advantage would be gained: there is on that account a phyſical neceſſity that the ſea ſhould conſtantly flow in without ebbing back: this neceſſity however does not exiſt at the entrance itſelf, becauſe there are not materials for decompoſition, and hence a ſmall eddy on each ſide near the ſhores is generally found. But in the Mediterranean itſelf no ſuch effect is diſcovered—either ſea-water muſt conſtantly be ſupplied, or the whole muſt decay. The efficient means employed to obviate this phyſical evil are two:

1. The diſſimilitude of various bodies.

2. The ſpecific gravity of ſea-water over freſh; ſea-water containing $\frac{1}{21}$th of its weight of ſalt.

When therefore both meet, both muſt unite. This junction ariſes not only from the effect reſulting from chemical decompoſition, but from the difference of their ſpecific gravities ; they therefore join on the ſame principle as cold air ruſhes into and mixes with hot ; the ſaline materials of which it is compoſed develate and decompoſe the impurities the rivers have carried in, and by this ſeparation allow the parts to return to their *wholes* : hence we find the entrance of all rivers abounding with mud and ſlime, decayed ſubſtances that ſeem to be compoſed of animal, vegetable, and earthy matter, combined with a quantity of air in a ſtate of fermentation.

When theſe rivers flow into the ocean, the ſaline materials of which it conſiſts are adequate to the perfect decompoſition, without fermentation; but where the quantity of decayed materials is great and the ſupply of ſea-water ſmall, fermentation becomes a neceſſary auxiliary, and a larger quantity of mud is produced: this is abundantly exemplified at the bottom of the Mediterranean; at the mouths of the river Nile, a ſituation ſo remote from the ſea that there muſt be a deficiency of ſea-water, although the putrid materials carried by theſe rivers is very great: hence it is found that mud is generally very abundant.

Rivers therefore may be conſidered as conductors of putrid matter, and the ſea as the general purifier.

If rivers had been ſaline, and the ocean conſiſted of freſh water, the former could not have contained a ſufficiency of this renovating principle equal to the waſte carried away by the latter; and as all rivers flow through the land, if the purifying proceſs had commenced in them the ſurrounding country muſt have been injured by it. Hence therefore the neceſſity of an ocean of ſea and rivers of freſh water, of the fixity of ſalts, and the relative volatility of water.

CHAP. VII.

ON THE ATTRACTION OF GRAVITATION.

THE general fact, that all ſolid bodies have a tendency to remain inert on the ground, and that they invariably return if they be propelled from it, has led to this falſe though ſpecious concluſion, that there is a principle inherent in matter, called attraction, the power of which depends on the quantity of matter a body contains; and as this terreſtrial globe poſſeſſes the greateſt magnitude with reſpect to its parts, it therefore had the power of attracting all bodies to it. This ſpecies of attraction has been diſtinguiſhed by the appellation of gravitation, having for its laws not only the quantity of matter, but that its force increaſe as the ſquares of the diſtances decreaſe.

Connected with this active principle, another of a directly oppoſite nature has been acknowledged, called by the name of *Vis Inertia:* the firſt would ſeem to be a principle of action; the ſecond of reſt: but to ſay that the ſame matter is inherently inert, and that it poſſeſſes with this inertneſs an inherent active power, is attributing to it, if not an *attraction of repulſion*, certainly a *forceleſs force;* it is making inertneſs the ſame as power, and power the ſame as inertneſs, which is both contradictory and abſurd.

It is not ſurpriſing that Sir Iſaac Newton ſhould have been very anxious to eſtabliſh this power in matter, as it forms the corner ſtone of his ſyſtem; for if it can be proved that matter is deſtitute of this principle, then nothing remains, as effects flowing from this cauſe, of either the centrifugal or centripetal forces, of attraction and repulſion, of motion and of reſt, but the name.

It is very true that he did not pretend to explain this principle, although he conſtantly employed it in ſolving the phenomena of nature, and his deductions are in general founded on its power.

I have endeavoured to prove that there

was a principle in the univerſe, of an incorporeal ſpecies, called Nature, which conſtitutes the connecting link between the particles of matter; that although in its eſſence it is incorporeal, yet being the laſt of immaterial cauſes, it participates in a degree of the quality of matter, and therefore may be called incorporeally corporeal: that this is the principle that regulates the laws of the univerſe, of which the ſenſible parts of it are nothing more than means conducive to an end: it is this principle in which action eſſentially reſides, whilſt matter itſelf is only the recipient, and made to act by virtue of this power. Nature may be ſaid to be ſimilar to the harmony exiſting in the chords of a muſical inſtrument, becauſe ſuch harmony is inſeparable from them.

Ariſtotle therefore very beautifully compares nature to an artiſt included in the ſubject of his art; as for inſtance, a ſhipwright ſhut up in the timber from which he builds a ſhip.

When matter is therefore called forth into action, it becomes a living ſyſtem but when nature reſides in it, in capacity alone, its only object is to preſerve the connection of parts and the regularity of the whole: this connection is called the attraction of coheſion; and this regularity conſiſts in the different elements preſerving their identity, and that the parts which flow from them may have a conſtant tendency to return to their ſource. Gravitation therefore is not more eſſential to ſolids than evaporation is to air, or for water to remain ſtationary between both.

If therefore the principle of gravitation be eſtabliſhed, the principle of levity muſt enſue; for the firſt cannot be acknowledged and the latter denied, as it is as eſſential for fire to aſcend, as it is for a ſtone to deſcend.

But by the principle of gravitation is underſtood a conſtant and active power that draws all bodies to the centre: why then does a bubble of air, or a piece of cork at the bottom of water conſtantly riſe to the top, and exert as much force to effect it as a ſtone does to fall to the bottom? for if gravitation be a thing poſitive, it ought to exert its influence equally upon all bodies; and as its force is the greateſt when the ſubject is near to the cauſe, the cork and the bubble that are at the bottom ought to be there much more firmly fixed than the ſame ſubſtances in the air; and yet we find theſe ſubſtances in different ſituations move in directly contrary directions; at the bottom of water they riſe, in the air they fall: to explain this away, the doctrine of ſpecific gravity was invented. By ſpecific gravity we find that the principle of gravitation depends on the quantity of matter a body contains, and that the power of it increaſes as the ſquares of the diſtances decreaſe, ſo that this power muſt at laſt be entirely loſt; it is in truth making it a power, and not a power.

It appears to me that although the effects are true, yet the principles from which theſe effects are ſuppoſed to ariſe are totally falſe: let us therefore examine the facts.

1. It

1. It is a fact, that a feather or a piece of cork, if placed at the bottom of water, will float to the top in unequal times.

2. It is a fact, that if they are put at the bottom of an exhauſted receiver, they will not riſe, but remain motionleſs and fixed at the bottom.

3. It is a fact, if a feather and a guinea, or any heavy and light body, are dropped from any diſtance in the open air, that they will reach the ground at different intervals of time, the heavieſt the firſt, the lighteſt the laſt.

4. It is a fact, that if the feather and the guinea, or any light and heavy body, are dropped together in an exhauſted receiver from equal heights, both will reach the bottom together.

Here then is a great variety in all the

caſes: it cannot ariſe from a different influence in the power of gravitation, it muſt be the ſame in both, ſince the bodies are placed at equal diſtances; it cannot ariſe from the difference of the quantity of matter, ſince the feather and the guinea reached the bottom together and at once: it muſt therefore ariſe from the difference of the medium; but if it ariſes from the difference of the medium, it cannot ariſe from the attracting power of the earth; and if it does not proceed from the attracting power of the earth, then it follows that the principle of gravitation is only a relative and not a poſitive principle. The queſtion then is, by what ſtandard is this relation to be meaſured? I anſwer, the quantity of matter with relation to the medium: it is the nature of the medium that determines whether a body ſhall aſcend or deſcend, or remain ſuſpended; the active power of Nature, that reſides not only in the medium but in all matter, having for her object the return of *parts* to their *wholes*. Light, therefore, is eſſentially rarer than air, air than water, water than earth.

It is the ſpecific relation of the medium with reſpect to the object, that decides the gravitating or aſcending diſpoſition; for if it be aſcribed to the earth when a body deſcends, it cannot be refuſed to the upper regions when a body aſcends, or to the air when it remains ſuſpended. The fact is, that this power neither reſides in the one nor in the other; it is Nature, that univerſal principle that exiſts every where, that decides the point: Nature decides at once in her unerring ſcales whether a body does or does not contain more matter than the medium; if it does contain more matter, then it deſcends; if equal, it remains ſuſpended; and if [illegible]in leſs, then it aſcends: the middle one ſeems a neuter quality, although there is a limitation to the two extremes.

This limitation ariſes not only from the quantity of matter with reſpect to the medium, but the relation that *parts* have to their *wholes*: for as no part can be ſo conſiderable as the whole, it is therefore impoſſible for any falling body to penetrate beyond the ſurface; and the whole terreſtrial globe being ſpecifically heavier than any part of it, the whole will therefore preſerve its proper rank, and the part cannot penetrate: and as the matter of light is ſpecifically rarer and lighter than any aeriform fluid, that fluid muſt find its ultimatum of aſcenſion; becauſe in its aſcenſion it arrives at a point where it becomes ſpe[illegible]eavier than the medium of light.

If this were not the caſe, men might aſcend into the air as well as birds, and birds might fly to an indeterminate height; but there is a *ne plus ultra* to both. The power of birds in aſcending depends on the ſpecific quantity and levity of their feathers with reſpect to the medium, and the power of animals to remain fixed on the ground on the ſpecific gravity of their bodies in relation to the medium alſo; hence therefore, we find thoſe birds that aſcend the greateſt height have not only the ſtrongeſt powers, but the largeſt feathers alſo, whilſt the aquatic birds have them leſs in quantity, and more of a downy nature; and terreſtrial animals, deſtined by nature to inhabit the earth, are altogether depri[illegible] of theſe powers (the lungs excepted). If the anatomy o[illegible] fiſh be examined, it will be found exactly to be fitted for the element in which they live.

As the whole of this principle depends on the nature of the medium, it evidently follows, that the weight of a body muſt decreaſe in proportion as the ſquares of the diſtance from the earth increaſe, and that a falling body will have its motion accelerated in the ratio of its approach to the earth. If a body be weighed at a great height, where the medium is rare, the weight of the atmoſphere above is not only diminiſhed, but the reſiſtance of the medium below increaſed, owing to the column of atmoſphere being greater; but if it be weighed near the ſurface of the earth, the column of atmoſphere above is greater, and the preſſure therefore increaſed; and as the column of atmoſphere below is leſs, the reſiſtance is diminiſhed. Hence it follows, that a body muſt be heavier near the earth, than on the top of lofty mountains.

On this principle it is that the motion of falling bodies is accelerated as the ſquares of their diſtances from the earth decreaſe, not from any attracting power of the earth, but becauſe reſiſtance continually diminiſhes as the medium is reduced: for example, if a column of atmoſphere, at the diſtance of 100 feet, weighs 20 lb. and a body at the extreme point be let fall, the 20 lb. weight muſt neceſſarily impede its motion; at 50 feet, it will only have the reſiſtance of 10 lb.; and at 25, only a reſiſtance of 5 lb. Bodies therefore in vacuo are much heavier than in air.

Great diſputes have ariſen amongſt chemiſts as to the nature of the matter of fire, ſome alleging that it was ſpecifically light, and others that it was not. The matter of fire is perhaps the rareſt compound body exiſting, although infinitely more opake than the element of light, one of its conſtituent parts: if therefore the matter of fire could be weighed in the element of light alone, fire would be found to be much heavier than it; but as its parts are much rarer than the atmoſphere, fire therefore will be found lighter; although, if a receiver were completely exhauſted, and nothing left but the matter of light, fire would then be found to ſink. This we know to be the caſe with ſmoke, in which a large quantity of the matter of heat is involved; the ſmoke at firſt aſcends, but as the air becomes exhauſted and taken away, the ſmoke is kept ſuſpended, and at laſt falls to the bottom: the reaſon is, that it is then ſpecifically more opake than the medium in which it is weighed.

Fire therefore, when combined with denſe bodies, will make them light in the ratio of its rarity with the medium, on the ſame principle as corks are employed to buoy up bodies in water.

But, reaſoning in the abſtract, there can be no doubt that the matter of fire is in its nature eſſentially heavy with relation to the pure matter of light, but ſpecifically light with relation to other bodies.

I muſt alſo add, that thoſe who have an idea that a perfect vacuum can be produced, are groſsly miſtaken; the atmoſphere may be exhauſted from a receiver, but a man might pump for ever before he could exhauſt the matter of light. This matter, being infinitely rarer than all other bodies, penetrates through their pores, and ſupplies the place where the groſſer parts have been taken away or conſumed.

If theſe general principles reſpecting the powers of attraction are true, Sir

Iſaac Newton's muſt be falſe, and a different ſyſtem from the Copernican muſt follow: yet although his principles are falſe, it is notwithſtanding very poſſible that his calculations may for the moſt part be correct: the nature of the medium being permanent by which theſe calculations were made, the reſult muſt be the ſame.

PART II.

CHAP. VIII.

ON THE PROCESSION OF THE ELEMENTS, AND THE NATURE OF LIGHT AND HEAT IN PARTICULAR.

THAT light and heat are effects of which the ſun is the principal cauſe, appears evident from the ſenſible conſequences that are felt and diſcovered, not only in the temperature of the air, but in the illumination and darkneſs exiſting in the globe, either by its preſence or abſence. When both light and heat are abſent from us, it is not becauſe the ſun ſuſpends its energy, but becauſe we are ſituated beyond its influence. It however becomes a queſtion, whether the matter of light and the matter of heat (or fire) are one and the ſame? or whether the matter of light may not be the parent of fire, as light itſelf is the offſpring of the ſun?

That the ſun is the principal ſource of light appears certain from the experiments that have been made on its rays, from the illuminations cauſed by its preſence, and from the darkneſs or privation of light occaſioned by its abſence. The rays of the ſun are eſſentially luminous; were they otherwiſe, we could form no idea of their origin, and the whole world would be covered with impenetrable darkneſs, with the exception perhaps of the light emanated from the fixed ſtars, and others of the heavenly bodies.

It is therefore neceſſary to examine the nature of light and heat, which all bodies, by us called combuſtible, are capable of producing; it however appears to me, that theſe two phenomena are different in their natures, and diſtinct in their operations. If light and fire were the ſame, light could not exiſt without the preſence of heat, nor heat without the preſence of light; the privation of light would always be attended with the privation of heat—there might be a difference in degree, but the effect would be the ſame; bodies the moſt white would be the moſt hot, and cold would be a quality inherent in all dark matter. Snow therefore ought to be infinitely hotter than water, and a heated coal more frigid than ice.

The temperature of the air above the region of clouds would be intenſely hot alſo, becauſe more proximate to the ſun; for the ſame reaſon the cold would be much more ſevere on the plain than on the ſummit of the moſt lofty mountains, for the denſity of the medium through which the rays would be received muſt neceſſarily tend to diminiſh, if not entirely deſtroy their influence.

An enquiry therefore on the comparative difference of the temperature of the air in different degrees of altitude and latitude, will aſcertain whether the rays of the ſun are *poſitively* hot or not; the ſenſible appearances above the atmoſphere, or at leaſt above the region of clouds, are the ſituations from whence the moſt certain concluſions can be drawn, and the moſt certain criteria by which we are to judge. Since light is there pure and free from the operation of extraneous cauſes, if we find, whenever water aſcends the moſt lofty ſummit of the moſt lofty mountains, that it immediately paſſes into a ſolid form, and that the temperature of the air is there extremely cold, however proximate it may be to the ſun; it will lead us to this important concluſion, "*that the ſun is not the immediate and ſolitary cauſe of heat.*"

The altitude of a mountain is either poſitive or relative; poſitive when meaſured by itſelf, and relative when compared with another—as the Glaciers in Switzerland, however high in themſelves, are relatively low when compared to Mount Blanc, whoſe high top overſhadows them all. Mountains alſo are diſtinguiſhed by their ſituation, and the vegetable productions which they yield. Travellers who have aſcended the higheſt mountains both in Europe and within the tropics, have uniformly found the temperature of the air vary in their aſcent, changing from the moſt intenſe heat to the moſt penetrating cold.

The Andes, that are ſituated almoſt immediately under the line, and that reſt on burning ſands, have their middle temperate, on which the city of Quito is built, although their tops are encircled with ſnow coeval perhaps with their exiſtence. Travellers have been able alſo to aſcertain in ſome degree the height to which the atmoſphere exiſted above the ſurface of the plain below. The common temperature below varied according to the latitude of the country; but the temperature above was uniformly the ſame, and the ſummits of thoſe mountains were conſtantly covered with ſnow. The air has alſo generally been found extremely cold by aëronauts, who have aſcended to a great height.

The rays of the moon, collected at night by concave mirrors, I am told, have been found to ſink the thermometer to a low degree; and a thermometer included within the receiver of an air-pump will have its mercury ſunk two or three degrees, as the air beomes exhauſted. This evidently ariſes from the privation of the atmoſpheric air, which I conſider as abſolutely hot, and left to the effect of the matter of light, which I conſider as totally unconnected with this quality.

Hence it follows that the rays of the ſun are not poſitively hot, and that heat is produced either by a combination of thoſe rays with other bodies, or that the matter of heat has another ſource.

That the ſun is one of the principal conſtituent ſources of heat, appears certain by a review of the different temperature of the air in different countries from the line to the poles; and it will uniformly be found (with certain exceptions connected with local peculiarity) that the air is the hotteſt underthe line, becoming progreſſively colder towards the poles *.

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* When the temperature is meaſured on the plane.

The temperature alſo varies in every country at different periods of the day, according to its proximity or diſtance from the ſun; and the moſt intenſe fire perhaps that can be excited is by collecting and condenſing the *combined* rays of the ſun through the medium of burning glaſſes.

Although I aſſert that the ſun is totally deſtitute of heat, it does not from thence follow, that cold is one of its inherent qualities: the ſun in the abſtract is the cauſe and ſource of light; the effect immediately proceeding from that cauſe muſt therefore be illumination. If it were to produce any other *immediate* principle or effect, that other effect would be different from its cauſe; but it is a law of nature for every elementary body to energize according to its own nature, and that the cauſe is primarily what the effect is ſecondarily. The eye therefore might as well become the organ of hearing, or the ear the organ of ſeeing, as for the ſun to produce any other immediate attribute than light. Pure light, therefore, ſubſiſting in the ſun is neither hot nor cold, but is the primary principle of heat afterwards by combination with other bodies; and as every primary cauſe tranſcends the nature of its effect, the rays of light are continually loſing ſome part of their purity and power as they reach the earth.

CHAP. IX.

ON CREATION.

SEEING then that the ſource of light is the ſun, and that light is one of the cauſes of heat, it becomes a queſtion of conſequence to inveſtigate by what means the matter of light produces the matter of heat.

As the various productions and changes of natural bodies proceed from the different combinations of matter out of certain elementary particles, and as theſe combinations depend not on things ſimilar, but diſſimilar,

diſſimilar (for if the univerſe had conſiſted of one homogeneous body no change whatever could have taken place; if this univerſe had conſiſted of one *wholeneſs* of light or of fire, it is impoſſible that either darkneſs or cold could have exiſted, for as *wholes* they could not have been acted upon); hence therefore the neceſſity of original elements of diſſimilar kinds, by the union cf which other compound bodies might ariſe.

It is a law of nature, that the junction of bodies is ſlow and inſenſible in proportion to the ſimilarity of the two bodies, and ſudden and violent in the degree of their diſſimilarity: thus we find that when two bodies, the one very hot the other very cold, approximate to each other, an union enſues with great rapidity,

rapidity. When electric matter approaches a non-electric, a combination of both takes place with great violence, but the union is proportionably ſilent and ſlow as they both mutually agree.

Let us therefore apply theſe principles to the formation of this world out of chaos, and to the production of heat, "when the earth was without form and "void, and darkneſs was on the face of "the deep, and the ſpirit of God moved "on the face of the waters," at that eternity [*].

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[*] It cannot be called time, for time had then no exiſtence: time is that by which ſenſible and corporeal things are meaſured; eternity, by which immaterial and immortal eſſences. As ſenſible things are conſtantly mutable, they are in their nature periſhable,

The body of the world conſiſted of earth and water in a ſtate of chaos; but when God ſaid, "Let there be light, and "there was light," out of the creation of this new element a new order of things immediately aroſe, and effects the moſt violent inſtantly followed.

It is ſcarcely poſſible for us to conceive in the preſent arrangement of the world, the ſhock that muſt have attended creation; the order and the regularity of the world are preſerved by the different elements retaining their proper and ſubordinate places; but whenever this order is

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riſhable, and of courſe cannot be the ſubject of an eternal meaſure; but on the contrary, immaterial eſſences being conſequently immortal, are infinite and eternal, and therefore cannot be meaſured by the fleeting nature of time.

is diſturbed, either by the increaſed power of one element, or the ſubtraction of another, or the junction of oppoſite elements, violence is produced correſpondent to the nature of the element concerned. It will be neceſſary to attend to what I remarked on Elective Attraction: it was proved that violence was ever the conſequence of the junction of oppoſite elements, although each proximate element united without any particular effect: the world therefore, in a ſtate of chaos, conſiſted of earth and water, and remained in an undiſturbed condition; but when light was called forth it became the proximate element to water, and the moſt remote from earth: light therefore paſſing through water reached the earth, with which it combined with violence; this violence was the conſequence of the combination of theſe two elements, and the violence of their combination was owing to their diſſimilarity. It is impoſſible that any other two elements could have produced ſuch effects, becauſe not ſufficiently diſſimilar; the office was therefore allotted to the moſt excellent and rare, and to the moſt indigent and opake, by the violent junction of which earthquakes in every part were produced, and the matter of heat was generated *: the matter of heat therefore is a generated matter ariſing from the union of light with earth. As the matter of light was then in its moſt pure and vivid form, its power muſt have

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* I ſhall hereafter prove that earthquakes ariſe from this cauſe, and that whenever there are earthquakes there is a production of heat.

infinitely ſurpaſſed what it does at preſent on the ſurface of the earth, becauſe that power is abated by the combination of the rays with atmoſpheric matter.

Notwithſtanding this, it is poſitively ſtated, that the *pure ſolar* rays act as the moſt intenſe fires in vacuo, and that earthquakes are accompanied with ſtreams of fire: may we not then aſcribe the irregularity of land on the face of the globe, and the ſeparation of the ſea from the land, to the violence that muſt have attended creation?

That heat is produced by the combination of oppoſite elements is further illuſtrated, by obſerving the effect of light falling upon ſnow in different ſituations. When the rays of the ſun fall upon pure ſnow, either in the country or on mountains, they paſs through without the power of melting it; but when they reach the earth (the oppoſite element to light), heat is then produced; the ſnow therefore always melts from the bottom to the top, whilſt water freezes from the top to the bottom: and I am perſuaded if the ſummit of the Andes could be explored, immenſe caverns would be found to exiſt in conſequence of the heat produced by the combination of the ſun's rays with the earth*.

But when ſnow falls in towns, where it is ſoon mixed with earthy matter, the rays of the ſun, uniting with thoſe matters, produce through the whole maſs a degree of heat: ſnow therefore melts faſter in town than in the country; and it is owing to ſome peculiarity of this kind that we ſee ſnow melting with greater rapidity in ſome parts of the ſame field when equally expoſed to the ſun.

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* I have been ſince told that theſe caverns are frequently met with on the top of the Alps, &c.

The experiments of Cavallo are directly in point. Cavallo placed different thermometers in the ſame ſituation with reſpect to the ſun: having previouſly painted their bulbs of different colours, he found the mercury roſe much higher in the thermometer whoſe bulb was painted black than in any of the reſt; in the reſt there was a certain proportion kept, and the thermometer that was left unpainted was found to have its mercury lower than the others. This abundantly proves, that the more different the opake matter is to light, the more heat is produced: this is the reaſon why black clothes in ſummer are found hotter than any others, viz. becauſe a combination of the rays takes place, and heat is then produced.

So far therefore from heat having its ſole origin in the ſun, it was firſt formed in the bowels of the earth, by the junction of oppoſite elements: heat therefore is a compound body, bearing the ſame relation to light and earth that ſmoke does to air and fuel. It muſt be very difficult to inveſtigate the chemical properties of this pure matter of heat; it can beſt be done on the higheſt ſummit of the moſt lofty mountains, in the excavations that exiſt contiguous to the earth, by the ſnow it has melted. It is ſcarcely poſſible to do it on the plane ſurface, becauſe it cannot be found uncombined with foreign matter.

This matter of heat is the baſis of pure air; this it was, after being produced in the bowels or on the ſurface of the earth, and uniting with water, which formed air —pure air forming a medium between light and water, as air and water are the connecting media between light and earth. So far therefore from water having its origin from the combination of different airs, as the preſent chemiſts almoſt univerſally believe and teach, air is formed by the union of the matter of heat and of water: both heat and air therefore are now contained by the earth and its various productions *.

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* The experiments of Sir Benjamin Thomſon, Dr. Prieſtley, and others, are ſtrongly illuſtrative of the hypotheſis I have endeavoured to eſtabliſh.

1. Sir Benjamin Thomſon introduced 30 grains of raw ſilk, previouſly waſhed in water, into a thin glaſs globe 4 ½ inches diameter, having a cylindrical neck ¾ of an inch wide and 12 inches long; inverting the globe into a jar filled with water, and expoſing it to the action of the ſun in the window. It had not been ten minutes in this ſituation, when the ſilk became covered with an infinite number of air bubbles, gradually increaſing in ſize, till at the end of two hours the ſilk was buoyed up by their means to the top of the water.

By degrees they began to ſeparate themſelves, and form a collection of air in the upper part of the globe, which when examined by the teſt of nitrous air appeared to be very pure. In three days he had collected

I might have extracted a volume of experiments in proof of this general fact,

that

collected 3 ¾ inches of air, into which a wax taper being introduced, that had juſt been blown out, the wick only remaining red, it inſtantly took fire, and burnt with a bright and enlarged flame.

This experiment was repeated ſeveral times with the ſame reſult—but with this difference, that when the ſun ſhone very bright the quantity of air produced was not only greater, but its quality ſuperior to that yielded when the ſun's rays were very feeble, or when they were frequently intercepted by flying clouds. The air however, ſays he, was not only much better than common air, but even than that produced by the freſh leaves of plants expoſed in water to the ſun's rays in the experiments of Dr. Ingenhouſz; and under the moſt favourable circumſtances it was ſo good, that one meaſure of it required four of nitrous air to ſaturate it. The medium heat of the globe when expoſed to the ſun's rays was from 90° of Fahrenheit to 96, although air

was

that whenever heat was applied to water a large quantity of air was the reſult;

but

was frequently produced when the heat did not exceed 65 and 70.

2. He expoſed the globe full of freſh water in a dark room, ſurrounded with lamps and reflectors, diſpoſed in ſuch a manner as to throw as much light on the ſilk, taking care at the ſame time that the water ſhould not acquire a greater heat than 90. In this ſituation in ten minutes the ſilk began to be covered with air bubbles, and in ſix hours as much was collected as could be proved by nitrous air.

3. Various other opake matters were ſubſtituted for raw ſilk, the reſult of which was the ſame; but it was found that when freſh vegetables were ſubſtituted for the ſilk, a leſs quantity of air was produced.

4. A thin glaſs globe, containing 296 inches, being filled with freſh ſpring water, and 30 grains of raw ſilk immerſed in it, was expoſed to the air

for

but as the matter of heat produced by the rays of the ſun combined with opake matter is much purer than that heat which is occaſioned by culinary fires, it follows, that there will be a greater proportion of pure air produced from the firſt than by the latter method. It is

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for three days in the month of May, but for the moſt part cold and cloudy. During this time only 9 $\frac{1}{2}$ of air were produced; the next day, by expoſure to a bright ſun from nine in the morning to five in the afternoon, 8.46 inches more were produced; the next day the product of air was 9 cubic inches, of a better quality; the next day ſix inches of a better, though expoſed only for three hours; but the next day, it being cold and cloudy, only $\frac{3}{4}$ of an inch of air was produced, and theſe manifeſtly inferior to the foregoing. No more air could afterwards be produced excepting one quarter of a cubic inch, ſo that from 296 inches of water 33.96 of air were obtained.

ſomewhat ſurpriſing that neither Sir Benjamin Thomſon nor the other ingenious men concerned in making theſe experiments ventured to aſcribe cauſes to the effects they beheld.

Had they known that heat was the conſequence of the combination of the ſun's rays with opake matter, and that the more obſcure this opake matter was the greater heat was produced, as amply proved by the experiments of Mr. Cavallo on the thermometer *, they muſt have

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* As a farther illuſtration of this fact I ſhall relate another experiment of Sir Benjamin Thomſon. He filled a large globe with ſpring water, having introduced into it a quantity of the fine thread of glaſs, commonly called ſpun-glaſs, ſuch as is uſed for making a bruſh for cleaning jewels; the reſult was, that the

have been led to conclude, that when the ſun's rays came in contact with the ſilk, heat would be generated contiguous to the ſilk; and that when heat was there generated, air would be formed from the combination of it with water; for it has been found, that when water has been expoſed to a certain degree of heat a quantity of pure air has been emitted. And it was owing to the purity of the

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the globe being expoſed to the ſun, air bubbles began almoſt inſtantly to make their appearance on the ſurface, and in 4 hours 0.77 part of a cubic inch of air was produced, which with nitrous air ſhewed a quality of 88, after which not a ſingle globule more was procured, though the globe was expoſed for a whole week in fine ſun-ſhine weather. Hence it appears that more than mere ſurface is neceſſary to produce dephlogiſticated air from water by means of the ſun's light.

ſpun-glaſs, and the ſmall quantity of opake matter it contained, that ſo ſmall a proportion of air was procured, as there were not ſufficient materials for the ſun's rays, by the combination of which heat could be produced: it is not therefore ſurpriſing if the fouleſt water will often yield the moſt air, becauſe it contains in greater abundance one of the materials for the formation of heat, without which no air can be produced.

As the proceſſion of the elements takes place from the moſt rare to the moſt denſe, it is therefore contrary to the order of nature to ſuppoſe that the firſt can be the cauſe of the laſt; it might as juſtly be argued, that water is the cauſe of earth, as to ſuppoſe that air is the cauſe of water. If this monſtrous inverſion of all ſymmetry could happen, it would lead to this abſurdity—inſtead of man, animals, and plants having the earth for their baſe, and air as the medium to exiſt and move in, they would have the air for a baſe, and the earth on their ſummits, unleſs indeed they had been formed by nature to ſtand upon their heads inſtead of their heels.

CHAP. X.

ON THE MATTER OF HEAT.

THUS then have I reduced the original elements to three; but as the purpoſes for which *form* was given to the world could not have been anſwered without heat and air, theſe aroſe immediately out of the others.

The world was intended by its formation to be the ſeat and region of animated natures; and as theſe could not exiſt without heat and air, it therefore became

neceſſary

neceſſary that both ſhould have a prior exiſtence: heat and air therefore were formed poſterior to creation, but prior to generation.

Pure air therefore is a compound body conſiſting of the matter of heat and of water, and the variety of airs all depend on the different combinations of theſe elements with the variety exiſting of the other elements. As the matter of heat conſtitutes the baſis of air, air cannot exiſt without heat; and whenever heat is preſent a diſpoſition to an equilibrium takes place. The earth therefore, becauſe of its diſſimilarity to air, becomes heated; becauſe of its obſcurity, it becomes illuminated; becauſe of its inertneſs and imbecility, it becomes the ſeat of animation and action.

Pure air therefore will always be found in ſituations where light and opake matter exiſt in the greateſt purity: hence it follows, that it is more abundant in ſummer than in winter, in the country than in towns, and at ſea more than on land: and we may conclude, that in the beginning of the world, before the exiſtence of animal and vegetable life, this ſpecies of air alone exiſted.

Pure air becomes impure by the addition of atmoſpheric matter, and it is the whole of this combination that conſtitutes what is called atmoſphere. Atmoſphere therefore may be divided into two parts, one pure and the other impure: this impure part ariſes from the evaporation that is continually taking place from the various ſubſtances on the ſurface of the globe, or buried in the bowels of the earth, each peculiar body giving the air its peculiar quality by uniting with its baſe. The combination of theſe various bodies with the matter of light I conceive to be an eſſential cauſe of atmoſpheric heat, with its various changes of temperature; for, although they are not earth they are *earthy*, having their ſources from the earth.

That this is the caſe will be demonſtrated by a review of the different climates of different latitudes, of different altitudes of the ſame latitude, and the difference in both altitude and latitude at different ſeaſons, and at different hours of the ſame ſeaſon.

As light is one of the conſtituent parts of pure air, it will of courſe be found more abundant in ſummer than in winter, in the day more than at night *.

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* The experiments of Dr. Ingenhouſz are ſtrongly illuſtrative of this fact. He obſerved that plants in general have a power of correcting bad, and even of improving common air, in a few hours, when expoſed to the light of the ſun; but in the night time, or when they are not influenced by the ſolar rays, they contaminate the air.

A muſtard plant was put in a glaſs receiver containing common air, and its ſtem cut off even with the mouth of the receiver: the veſſel was then inverted into an earthen pan, containing ſome water to keep the plant alive; the whole apparatus was ſet over night in a room; next morning the air was found ſo much contaminated that it extinguiſhed the flame of a wax taper. On expoſing the apparatus to the ſun for a quarter of an hour, the air was found ſomewhat corrected; and after an hour and a half it was ſo far improved, that by the teſt of nitrous air it appeared conſiderably better than common air.

It is however to be obſerved, that air is not neceſſarily more impure in winter than in ſummer, becauſe air contracts its impurity by atmoſpheric matter, which will generally be more abundant in ſummer than in winter. Hence we find, that in cold froſty weather, even in the coldeſt countries, air is very pure: in thoſe countries the earth being generally covered over with ice and ſnow, there is on that account a deficiency of materials for atmoſphere, ſo that there is found not only a very pure, but a very cold air *.

In

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* This accounts why epidemic diſeaſes whenever they happen in the country are more univerſal than in cities, for the air that contains the poiſon being much purer is more immediately applied to the body; but in cities the atmoſphere is ſo thick that the epidemic

In the height of ſummer therefore the air would be moſt impure, if nature had not beneficently made the diſeaſe work its own cure: the ſummer is the ſeaſon of vegetation; and it is found that vegetables abſorb for food the moſt impure,

demic poiſon becomes more involved, and therefore cannot find acceſs to the body in ſo concentrated a ſtate. It may alſo be added, that the atmoſphere of cities is ſo replete with various poiſons, that the different powers of the whole tend to diminiſh the effects that might be produced from each ſeparately. Cities however will generally be the ſeat of contagious diſeaſes, becauſe the cauſe of ſuch poiſons will there be more abundant; and whenever they operate, it muſt ariſe from their very great power, and therefore the diſeaſes cauſed in conſequence are generally very violent. All epidemic diſeaſes are contagious, but all contagious diſeaſes are not epidemic.

and eject as excrement the moſt pure air: this act of renovation however is limited to the day, for at night vegetables are found to emit air of a bad quality. M. Cavallo is of opinion, that the office of vegetables in yielding pure air begins a few hours after the ſun has made its appearance on the horizon, and that it ceaſes at the cloſe of the day, excepting ſome plants that continue it a ſhort time after the ſun is ſet. The quantity of good air is greater in a clear than in a cloudy day, and greater when the plants are expoſed to the ſun than when ſituated in ſhady places. He obſerves, however, that the damage done by plants in the night is more than counterbalanced by the benefit they afford in the day time. He found by a rough calculation,

that

that the poiſonous air yielded by any plant during the whole night could not amount to an hundredth part of the pure air which the ſame plant produced in two hours time in a fair day.

Although this latitude bears the ſame proximity to the ſun at the vernal and autumnal equinoxes, it is found that the temperature of the air is very different, and that the ſpring is conſiderably colder than the autumn.

In the ſpring, whilſt vegetation is commencing, the ſun has not the other conſtituent materials for the production of heat in ſuch abundance; but in the autumn, the quantity of vegetable matter that is periſhed furniſhes the neceſſary ingredient, and therefore the temperature is then generally high.

From theſe principles it is that the air is warmer in the day than in the night, in the evening than the morning; warmer near the ſurface of the earth, and progreſſively cooling in its aſcent, until that point of altitude is attained, where neither heat nor air can exiſt, becauſe there are wanting the opake matter and water, two of the conſtituent parts neceſſary for their formation.

This is the region of pure light, whoſe true element ſubſiſts where the region of air has its end; all the light therefore that we have on the ſurface of the earth is never pure, having been participated by various bodies. The light we receive is perhaps infinitely inferior to the element itſelf, as the pureſt light of the pureſt day is ſuperior to the light obtained by the combination of the various bodies that exhibit it.

If the principles I have laid down are warranted by the experiments I have adduced, viz. that air is formed by the combination of the matter of heat and of water, it muſt follow, that the opinion of Lavoiſier, Cavendiſh, &c. &c. &c. is erroneous.

Water either is or is not an element: if it be an element, then it could not be formed by air, becauſe it is the property of an element to be the cauſe of producing, but not to be itſelf produced; if it be not an element, it is impoſſible that it could be formed by different kinds of air, as theſe gentlemen believe, becauſe there does not exiſt a ſufficient quantity of air that can correſpond in the ſmalleſt degree to the proportion of water contained in the world.

I would then aſk, whether it be reaſonable to ſuppoſe that the unfathomable deep, the rivers and lakes, and the water itſelf, kept ſuſpended in the air in the form of atmoſphere and clouds, can be the produce of air, ſince air itſelf, as well as atmoſphere, has its limitation of extent, more particularly as we find that water is 800 times more denſe than air? It might as well be ſuppoſed that all the water of the ſea is formed out of the rivers, inſtead of the water of the rivers being the reſult of evaporation from the ſea.

If air is the cauſe of water, the baſe out of which theſe airs aroſe muſt have exiſted before water; it therefore becomes a queſtion—whether the ſaline bodies out of which theſe airs were firſt produced did not ariſe from vegetable ſubſtances that have periſhed? If this be granted (and it cannot well be denied), it follows, that water had a prior exiſtence to air, becauſe vegetable ſubſtances owe their nutriment in a great degree to water, without which they cannot ſubſiſt. Water therefore muſt have exiſted prior to vegetables; but if water ſubſiſted before vegetables, it muſt have exiſted before air alſo. Since therefore ſaline bodies are the baſe of air, air cannot be the cauſe of water.

But if air is not the cauſe of water, and water is produced by the condenſation of air, it follows, that water is one of the conſtituent parts of air. This is the hydrogene of the preſent chemiſts, and the matter of heat (the ſource of which I have before aſcertained) is their oxygene.

It is a melancholy proof of the influence of experiments to ſee ſuch ingenious men as Lavoiſier, Cavendiſh, &c. publiſh ſuch opinions; and ſuch celebrated teachers of chemiſtry as Black, Babington, Higgins, &c. &c. inveſtigate the *wholes* of things in ſo contracted a way; and becauſe they can collect a few drops of water by the condenſation of various airs, that they ſhould be led to this important miſtake,—that all the water of the univerſe was the reſult of ſuch a combination! I am perſuaded that water would exceed air in ſpecific gravity in an unlimited proportion; hence there is a phyſical impoſſibility that air can be the cauſe of water. Thoſe therefore that obſtinately eſpouſe ſuch opinions muſt reverſe the axiom, " that things that are equal to the ſame, are equal to one another," and ſay, that things that are equal to the ſame, are *unequal* to one another.

CHAP. XI.

ON THE CAUSE OF ATMOSPHERIC HEAT.

AS the emanations of the ſun from the line to the poles have not the power of diſſolving ſnow, becauſe water in the ſolid form univerſally exiſts on mountains in every degree of latitude at certain points of altitude, although the temperature on the plain is found to vary infinitely— I am led to this important concluſion, that the ſun itſelf (*i. e.* per ſe) is not the immediate and ſolitary cauſe of heat, or of the variety in its temperature.

Although the ſun is the primary and conſequently not the ſolitary cauſe of heat, it is notwithſtanding found eſſentially inſtrumental to its actual exiſtence; for heat neither reſides in the earth nor in its productions, abſtracted from the influence of the rays of the ſun, either directly or indirectly. The immediate and proximate cauſe muſt therefore conſiſt in the combination of *both* the atmoſphere and the ſun; the atmoſphere becoming the pabulum to light, and light the pabulum to atmoſphere, the reſult of which is *heat*[*].

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[*] This very ſatisfactorily explains the fiery appearance of the ſun, both in the morning and evening, or during very cold or foggy weather. As the ſun when

If atmoſphere conſiſted of water alone, there would be no fuel for the rays of light until they reached the earth, and there would be heat only on its ſurface.

As the immediate combination of light and earth was the firſt cauſe of heat, and the matter of heat in union with water

when it riſes and ſets is nearly on a level with the horizon; the rays, by combining with atmoſpheric matter on that level make the whole medium of a red colour: the ſame happens when the denſity of the medium is increaſed either by foggy clouds, or the effects of cold; the ſun's rays, finding ſo much pabulum at that degree of altitude, produce heat: it therefore is always cold upon the plain until that increaſed quantity of atmoſphere can be conſumed and diſſipated, and the rays of light allowed to combine with the atmoſphere near the ſurface, or with the earth itſelf, the reſult of which is heat.

the firſt cauſe of air, air therefore became the natural medium between light and water; it muſt therefore follow, that as light is to air, ſo is air to water.

Since air when viewed as an element is ſubordinate to light, although conſtituted by it remotely and in part, it follows, that the combination of air with earth or other opake bodies will not produce ſuch violent effects as the junction of light itſelf with the ſame bodies: The diluted form of the ſun's rays, if I may ſo ſay, with the opake matter exiſting in and conſtituting atmoſphere, are the cauſes of its proper temperature, and prevent it from being a region of fire or of ice. There conſtantly exiſts in the atmoſphere a certain quantity of the matter of light and of air; it is ſo abundant in the day that it is obvious to the ſenſes; the abſence of the ſun at night diminiſhes the ſupply: there is notwithſtanding ſufficient reaſon to ſuppoſe, that a quantity of it in an uncombined ſtate does exiſt, and which is perpetually uniting with atmoſpheric matter during the night, by means of which a degree of heat is thus preſerved: before the dawn of day therefore it is always very cold, owing to the matter of light being conſumed; but when the return of the ſun affords a freſh ſupply, there is alſo an increaſe of heat.

We are able to exhibit this matter of light in a ſenſible ſtate in the moſt obſcure nights by means of the electrical machine.

The phenomenon of electricity produced by this means depends on a quantity of this matter of light being collected on the ſurface of the glaſs, and which is forced to unite by the revolution of the cylinder with a quantity of impure metallic matter in the form of an amalgam. By the friction thus produced a more intimate union of the matter of light and of the metal enſues, the conſequence of which is fire: this fire is the ſame as all other fires, differing only in point of tenuity and power: this difference ariſes from the materials of which it is compoſed, and the manner by which it is produced. This ſpecies of fire, like all others, may be extinguiſhed by means of water: this ariſes, as I ſhall explain, from the element of water being the next element to light and air, and therefore no violence taking place by their junction.

Hence it follows, that in moiſt weather the phenomena of electricity, as exhibited on the machine, muſt be greatly impeded: this impediment ariſes from the matter of light and of water keeping together their proper and ſubordinate ranks as elements, and therefore no ſuch violent effect as fire is excited: it is therefore neceſſary that the weather ſhould be dry when we wiſh to exhibit the violence of electric fire*.

As no part of the world is altogether deprived of light, and abounds with earth and water, ſo there muſt ever exiſt atmoſphere, and atmoſpheric heat *. So little is the ſun preſent near the poles in the

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* I hope at ſome future period to have leiſure to examine the opinions of the cauſes of electricity, as publiſhed by Dr. Prieſtley and Mr. Cavallo, as I am convinced that they are erroneous.

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* This is the reaſon why ſandy or clayey ſoils are always warmeſt in ſummer; for, being the pureſt parts of earths, water has not the power of combining with them; and as little atmoſphere can be formed from thence, they are conſequently of a dry nature: the rays of the ſun therefore finding no interruption come more directly in combination with the clay or ſand, and a greater degree of heat is produced, ſo that the ſand itſelf and the rays reflected from it muſt neceſſarily be very hot. But on the contrary, arable and paſture land, either in a ſtate of vegetation or cultivation, having in general a quantity of manure or water or both mixed with them, produce a quantity of atmoſphere above their ſurface, which arreſting the rays of light before they reach the earth, prevent the ſurface from being ſo much heated: ſandy ſoils therefore are always hotter in the day than thoſe known by the name of rich ſoils.

the winter, that the earth has not the proper quantity of light for the formation either of heat or of air; and therefore vegetation is ſuſpended, and the moſt intenſe cold there prevails: but as it has been proved that ſimilitude never changes, unleſs it be approximate to diſſimilitude,

ſoils. It is the direct and immediate combination of the ſun's rays with the ſand that produces heat: when therefore the rays of the ſun are abſtracted during the night, or intercepted by a thick atmoſphere in the winter, there is not any ſubſtance that can produce any internal heat; ſandy ſoils are therefore the coldeſt at night and in the winter. On the contrary, lands that contain a quantity of manure and other ſaline bodies, in conſequence of the diſſimilarity of theſe ſubſtances poſſeſs internal powers by which heat is conſtantly generated. Hence rich ſoils, ſo called, are never ſo hot in ſummer, or ſo cold in winter, as thoſe of a ſandy quality.

and that mutation depends on diſſimilitude, hence air will be unlike to either of the original elements. But as the degree of difference air bears to light and water will depend on the degree of diſſimilitude light and water bear to each other, and as water is the immediate original element next to light, both will meet in amicable conjunction, and no violence will be produced: air therefore ſerves as a medium to light and water.

But as earth is the next original element to water, both will unite without oppoſition, as explained on the ſame principles of light, air, and water; ſo that when the elements, of which this univerſe is compoſed, keep their proper and reciprocal ſtations, the whole is carried on with ſymmetry and order, the ſeaſons have their proper revolutions, and life and vegetation flouriſh.

But when this ſymmetry is deſtroyed by the union of the oppoſite elements, then violence muſt take place; but the union of oppoſite elements cannot take place without the diſpoſſeſſion of the intermediate one: thus light and water cannot immediately unite without the expulſion of air; air and earth without the expulſion of water; light and earth without the expulſion of both air and water.

Whenever theſe combinations and expulſions take place, violence muſt be the conſequence, differing in nature and degree according to the quality of the elements, and the remote ſituation of each of them.

Whenever the pure matter of light and earth immediately unite without the media of air and water, then exploſion and earthquakes are the direct conſequence.

Whenever light comes in direct contact with water by the diſpoſſeſſion of air, water-ſpouts are the effects that follow.

Thus it is alſo with that compound being man. When the ſoul energizes according to intellect, and preſerves the proper dominion over the corporeal nature, purity of mind and the love of ſcience are the effects: but when the natural and corporeal parts obtain the maſtery, and the ſoul is reduced to act according to corporeal impulſes alone, the ſymmetry is deſtroyed, and man becomes a prey to violence and the paſſions of the brute.

On theſe ſimple principles it is that the whole œconomy of the univerſe is preſerved and diſturbed, and on which the various ſubordinate phenomena of nature depend. But as theſe violent effects could not continue without deſtroying the whole order of the univerſe, the Deity therefore has eſtabliſhed certain laws for the government of it, of which nature is employed as the inſtrumental diſpenſer, ſubordinate to an over-ruling Providence, which directs and governs the world; ſo that theſe ſhocks of parts can never take place without an immediate diſpoſition to the reſtoration of ſymmetry and order, for the preſervation of the whole.

CHAP. XII.

ON THE CAUSE OF FIRE.

FIRE, therefore, I conſider to be a compound fluid, generated in conſequence of the direct and immediate combination of *oppoſite* elements, or of the violent agitation of ſolids upon each other in contrary directions.

In every caſe it is the reſult of the difference of quality and action of different bodies; for if the different elements of the world kept their proper ranks, and were either ſtationary, or moved in the ſame direction, no fire could be excited: thus we find that the eſſence of ſublunary fire conſiſts of pure light or air coming in direct contact with either animal, vegetable, or foſſil matter. Whenever theſe diſſimilar bodies come in immediate union by the diſpoſſeſſion of water, the intermediate element between the two, fire, combuſtion, or exploſion takes place; but whenever the ſymmetry is reſtored by the intervention of water, then all three preſerve their proper and ſubordinate ſituations, and the violence of fire, which had been excited by the oppoſition of the two extremes, ceaſes to rage. On this principle it is, that water extinguiſhes fire, or bodies ignited; and on the contrary, why ignition always thrives in dry ſituations.

The abſence of water therefore is favourable to inflammation. This is the reaſon why fuel burns beſt when it is moſt free from water, not when it is moſt dry alone; for we find fluids, ſuch as oils, ſpirits, &c. &c. which being the laſt produce of either animal or vegetable ſubſtances, are from their very nature diſſimilar to pure light or air, burn on the application of a ſpark when brought in contact with them: but on the contrary, the reaſon why ſulphur, charcoal, or the moſt inflammable ſubſtances, produce no ſuch effect in impure air, is, becauſe both are ſimilar by their mutual impurity.

If concentrated oil of vitriol be added

to pure water, a degree of heat above the boiling point will be excited.

If pure air and inflammable air be united, both will explode, &c.

The heat thus produced is the reſult of the difference of quality. Difference of action will have the ſame reſult. When a man hammers a nail, the hammer is in motion, the nail at reſt; and it is in conſequence of this conflict between motion and reſt, or the contrary direction of action, that heat is produced. No heat could be excited by theſe bodies if moved in the ſame direction. A flint will excite more fire upon a ſteel than two pieces of ſteel together, becauſe difference of quality is ſuperadded to difference of action. On the ſame foundation alſo it is that reſpiration is the cauſe of animal heat. In conſequence of the perpetual mutation and renovation the body undergoes, a quantity of mephitic matter is excreted from the lungs by expiration, and a large proportion of pure air is received in inſpiration: the junction therefore of both produces heat. The lungs are moſt admirably adapted to the production of this effect, not only from their ſituation, but from their magnitude and porous ſtructure, allowing by this means a greater extent of ſurface for this combination; and cold-blooded animals, that have no lungs, have no other animal heat than what the common temperature of the atmoſphere affords them. It is the plan of this work to inveſtigate cauſes, and not to deſcend into the explanation of particular effects; but every phenomenon exhibited by the preſence of fire may be explained on theſe principles.

Thoſe chemiſts therefore muſt evidently reaſon abſurdly, who ſuppoſe that foſſil bodies, reputed the moſt inflammable in nature, have inherently the power of inflammation; they become ingredients only to inflammation in the ratio of their diſſimilitude to light or pure air. Hence we muſt ſearch for them in a different region: the bowels of the earth therefore become the proper venters for their abode: this is the region of darkneſs, the moſt oppoſite to light, the region of bitumens, ſulphur, coal, and of that claſs of bodies commonly called inflammable: they are inflammable from their impurity and from their contrariety to the purity of light: hence we find them in mines and in coal-pits: the admiſſion of air into them often produces inflammation, becauſe the pure meets the impure, and the violence of combuſtion conſequently follows: this alſo is the cauſe why the air in thoſe ſituations is ſaid to be bad, becauſe thoſe caverns give out materials for ignition.

It is a curious circumſtance, which although conſtantly ſeen is ſeldom noticed, that all the materials ſubſervient to inflammation are conſumed and diſperſed during combuſtion: this ariſes from the warfare of the oppoſite elements, if I may ſo ſay, meeting and fighting together until they loſe their individual identity—producing heat, ſmoke, and reſiduum.

If I have been ſucceſsful in aſcertaining the true cauſe of fire, it muſt follow that the doctrine of *latent* heat, as introduced by Dr. Black, and further ingeniouſly explained by Dr. Crawford, is erroneous.

Although all matter has the capacity of producing heat when united to another portion of a different quality, or moved in a contrary direction, yet there is no homogeneous body in nature that poſſeſſes heat in itſelf and from itſelf: although the ſun is the primary agent when united with other bodies, it has not this power alone. All ſubſtances on the ſurface of the globe and to a conſiderable depth are combined with a quantity of air, and therefore contain a portion of heat: the heat thus produced is the reſult of combination, and is the cauſe why they are conſtantly changing and periſhing, and on the contrary, why ſubſtances are preſerved perfect and entire for a long time when totally excluded from the air, but crumble and are diſſipated by its admiſſion.

Porous bodies therefore are always the warmeſt, becauſe their ſtructure eaſily admits air into them, the reſult of which is heat, and conſequent decay: and on the contrary, the moſt compact bodies are the moſt cold, becauſe the cloſeneſs of their fabric excludes the air from them: they therefore preſerve themſelves unchanged, and on that account are always more durable. This perhaps is the reaſon why oak is more laſting than ſap, and ſap more laſting than touch-wood.

Although denſe bodies are of themſelves the moſt cold, they on that account become the beſt conductors of heat, becauſe heat as well as cold has a tendency alike to diffuſe itſelf every where: cold bodies therefore are good conductors of heat, and hot bodies are good conductors of cold.

I have no conception that fire can exiſt in the ſame ſubſtance in two ſeparate ſtates, in a latent and ſenſible form, at one and the ſame time: there is more reaſon to ſuppoſe that *latent* cold is a real quality inherent in matter than *latent* heat, ſince we find heat to be nothing more than an effect reſulting from the violence of combination; and cold of the moſt intenſe degree exiſts in ſituations where no ſuch combination does take place.

CHAP. XIII.

ON THE NATURE OF COLD.

HAVING endeavoured to aſcertain the laws of heat, it now becomes neceſſary I ſhould inveſtigate the nature of cold; whether it be a real quality inherent in matter, or whether, as the preſent chemiſts believe, it is a mere privation of heat.

As the matter of heat is a compound body, it cannot with propriety be called an element, for it is the property of an element to be the firſt conſtituent principle of a ſubſtance; individuality therefore ſeems eſſential to elementary matter: if ſo, no compound body can have that title given to it: at the ſame time heat is a property ſo univerſally diffuſed, that it ſurpaſſes both in power and extent any other of which we have any knowledge: when therefore this property exiſts in matter, its effects are made ſenſible by various phenomena: when it is totally abſtracted from that ſubſtance, other phenomena of an oppoſite nature enſue; in the firſt caſe expanſion takes place, in the laſt condenſation.

The queſtion then is, whether theſe two phenomena are to be referred to the ſame principle: I conceive it might as well be ſaid that light is the cauſe of darkneſs, and darkneſs the cauſe of light. The preſence of a cauſe is abſolutely neceſſary to the production of an effect: light is an effect reſulting from the preſence of the ſun: abſtract the ſun, and light ceaſes to exiſt, and the bodies that exhibited the phenomena remain dark: darkneſs therefore is a real quality of matter; and when illumination is excited upon matter, it is a quality ſuperadded to what is natural to it.

The error of philoſophers in making every quality of this kind a mere negation, has ariſen from drawing the ſame concluſion from animate as inanimate matter; but here the difference is immenſe. It is *natural* for the eye to ſee: the abſence of light therefore is total privation, becauſe viſion is a real quality of the eye: it is exactly the reverſe with inanimate matter, which is eſſentially obſcure, and therefore darkneſs is a real quality of it.

As expanſion is the immediate and univerſal effect of heat, it follows, that it cannot be the cauſe of condenſation: it might as well be ſuppoſed that cold is the cauſe of expanſion, as to ſay that heat is the cauſe of condenſation: but as we have direct evidence that expanſion is the effect of heat, it follows that cold is the cauſe of condenſation.

The effects of heat and of cold are equally definite and poſitive, although perhaps not equally univerſal; for as the matter of light in union with opake matter is one cauſe of heat, and as one of theſe two bodies is very generally preſent, it follows that all bodies poſſeſs one of the conſtituent principles for its formation, and therefore have a capacity for heat: but wherever the matter of light or of air has not penetrated, either in an elementary or combined ſtate, there poſitive cold muſt exiſt, and hence the bowels of the earth muſt be its region, and this is the reaſon which makes the ſurface of it the ſeat of ice and ſnow. It is very true, that water is ſeldom found in a ſolid form at any great depth: this is owing to the heat from the ſurface continually paſſing to the internal parts of the earth; by means of which it is warmed, and the ſurface left very cold: the ſame effect therefore takes place on the plain ſurface in winter that prevails on the tops of lofty mountains at all ſeaſons; the tops of theſe mountains are covered with ſnow for want of atmoſpheric matter, which is neceſſary for the production of heat. In winter there is atmoſpheric matter on the plain in ſufficient abundance, but a deficiency of the matter of light prevails: the ſame effect therefore takes place in the two ſituations from oppoſite cauſes.

That the temperature of mountains is low in ſummer is evident from every experiment on them, and from the ſnow that continually covers their tops.

That the temperature on the plain ſurface is low in winter, is proved from the deſcent of water in the form of ſnow: in winter water exiſts in the clouds; and when it approaches the earth it parts with its heat, becomes ſolid by turning into ſnow; and if water in a bucket be put near the bottom of a well, the water will loſe a quantity of its heat: theſe circumſtances evidently prove that cold does exiſt, and that the earth is its region.

Heat is not more ſenſible by its effects of expanſion, than cold by thoſe of condenſation; and as there is a gradual variety in both, and that they have a tendency equally to deſtroy each other, it follows that the action of both kinds is ſomething individual and diſtinct.

The effects of both are equally remarkable in animate and inanimate bodies; it is by theſe poſitive qualities that we find cold to be the oppoſite to heat, as quality to quality, not as a mere privation and negation.

It therefore only remains for me to prove, that cold as well as heat may be produced by artificial means: this is an effect ſo univerſal during the act of ſolution, that in the warmeſt countries ice is eaſily procured. Mr. Walker, who was engaged for ſome time in proſecuting experiments, with a view of aſcertaining the loweſt degree of cold that could be excited, found, that by mixing two parts of concentrated nitrous acid by weight, water one part—of this mixture cooled to the temperature of the atmoſphere 18 oz. of Glauber ſalt one pound and a half avoirdupois, and of ſal ammoniac 18 oz.; on adding the Glauber ſalt to the nitrous acid, the thermometer fell 52 degrees, that is, from 50 to 1°, and on adding the ſal ammoniac, to 9°: thus was Mr. Walker able to freeze quickſilver when the thermometer ſtood at 45. The manner in which he conducted the proceſs is rather tedious, and may be known by conſulting his book. The union of oil of vitriol, ſpirit of wine, and various other ſubſtances, with ſnow, produces very intenſe degrees of cold, in all caſes very conſiderably below the temperature of the atmoſphere.

I am not at preſent prepared to aſſign a cauſe for this intemperate effect; there can be no doubt, however, that the earth, at a certain depth, being deprived of the benefit of the ſun, will on that account be perpetually robbing the ſurface of its heat in winter, for the purpoſe of preſerving its own equilibrium; a ſtream of heat will therefore be continually paſſing from the ſurface towards the centre of the earth: this is the reaſon why the earth in winter, at a certain depth, is generally of an equal temperature, and never ſo cold as the ſurface: and on the contrary, when the ſurface is hotter in ſummer than the internal part of the earth, that evaporation takes place, and a ſtream of cold iſſues from the earth with a view of producing an equilibrium to the air; and it is this cauſe, I ſuſpect, that produces cold during the act of evaporation*.

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* The manner of making ice near Benares in the Eaſt Indies, is by dividing a piece of ground into plats four or five feet wide, and the borders raiſed four inches above the ſurface: dry ſtraw is placed in the cavities, and a number of earthen pans of a very porous quality are placed in them, ſmeared over with butter on the inſide: in the evening water is poured into them, and in the morning they are found covered with ice from one to two inches thick.

CHAP. XIV.

ON THE VARIATIONS THAT TAKE PLACE IN THE SYSTEM OF THE WORLD.

AS gravitation is cauſed by the quantity of matter a body contains with relation to the medium, it follows that evaporation is produced by the *rarity* of a body with reſpect to the *denſity* of the medium.

This is the general principle that regulates the aſcending and deſcending diſpoſition of bodies with reſpect to their matter.

The

The diſſimilarity of their qualities is the ſecond cauſe by which the junction is effected.

The difference of quality is the cauſe of the union of the particles of matter—difference of quantity produces the junction of different maſſes of matter. The quantity of matter is a relative term, depending on the relation of the medium, with reſpect to the ſubject; the quality of each is more poſitive, and produces more definite effects: the effects produced by quality alone are circumſcribed to the particles of matter; the effects produced by difference of quantity are unlimited, and produce union of bodies ſituated at the greateſt diſtance: hence it follows that difference both of quantity and quality is neceſſary for the intimate union of bodies.

If the univerſe had conſiſted of one element alone, or of different elements of different denſities and qualities that were conſtantly ſtationary, no change whatever could have taken place, and therefore it would have been unfit to be the ſeat of generation. An aſtronomer may ſee how neceſſary this terreſtrial globe is to the order of the univerſe, and to counterbalance the motion of the heavenly bodies: but a moral philoſopher contemplates the exiſtence of this earth, not only as a neceſſary part to terminate the proceſſion of the material world, but to be the ſeat of the laſt order of generated natures. Seeing as we do, that ſuch natures do exiſt, we are warranted to ſay that the Deity intended it ſo to be.

I might here enlarge on the nature of man, and of his fallen ſtate; of the Platonic opinion of the pre-exiſtence of the ſoul, and of its ſubſequent deſcent into body by which it became oblivious, and can only reſtore itſelf by a life of piety and virtue: this however is foreign from my preſent purpoſe, having for my object the inveſtigation of the phyſical cauſes by which the world is governed, and not the metaphyſical ſtate of things. As generated natures conſtitute an eſſential part of the order of the univerſe, and that theſe are expoſed to perpetual mutation and decay, it follows, that the elements in which they live muſt be perpetually varying in their nature alſo. If living beings were unchangeable and the elements variable, or living beings variable and the elements unchangeable, there could be no correſpondence between both, and confuſion would enſue: hence it follows, that a variation of the elements muſt take place.

The variations that take place in the ſyſtem of the world are effected by three different means.

1. Thoſe that proceed from the different denſities and qualities of the elements themſelves.

2. From the variety of motion effected by ſome of the elements, in conſequence of their perpetual revolution, more particularly of the ſun, by which the variety of ſeaſons is produced.

3. From the changes that take place in generated natures.

Having already ſpoken of the two firſt of theſe cauſes, it only remains that I ſhould ſay ſomething of the laſt.

The changes that take place in generated natures ariſe from the *limited* periods of their exiſtence, from being compoſed of different ſpecies of matter, and from undergoing conſtant mutation.

The principle of life with which they are endowed, although it compel them to ſeek for their ſubſiſtence, gives them the power of choice and of rejection; this power forming a very ſtriking difference between them and inanimate bodies. Inanimate bodies poſſeſs only the diſpoſition of junction, owing to difference either of quantity or quality; but the principle of life gives not only the power of junction, but of rejection alſo; and the digeſtive organs ſelect the parts that ſeem fit for the nutriment of the body, but reject by expulſion thoſe that are diſqualified for its ſupport; and when deleterious ſubſtances are taken in, and which cannot be rejected, inflammation and diſeaſe are excited. For the purpoſe of counteracting the operation of ſuch poiſons, the object in every caſe is the ſame; nature having in view the preſervation of the animated ſyſtem, and the completion of the final cauſes of things: there is therefore a time limited for the duration of life; for after it has gone through the deſtined period of its animal exiſtence it withers and decays, and the natural parts return to the elements from which they were formed.

Since then conſtant changes take place

on the ſurface of the globe, it becomes a neceſſary reſult that there ſhould be a variety in the influence of ſome of the elements. As the ſun is the inſtrumental cauſe employed by nature for the evolution of life, and as animal life is undergoing perpetual generation and decay, it follows, that the influence of the ſun ought to be more abundant at one ſeaſon than at another. If the ſucceſſion of animals and vegetables had been regularly produced and regularly deſtroyed in equal periods; if the period of their exiſtence had been definitely limited, as well as the production and deſtruction of their food, the ſame ſeaſons would have anſwered every purpoſe of creation.

But as creation is undergoing conſtant and irregular mutation, there is a phyſical neceſſity that the elements employed as efficient cauſes in the evolution of generated natures ſhould be more abundant at one ſeaſon than at another.

Thoſe countries therefore where the influence of the ſun is the greateſt, ſeem deſtined by nature for the greater abundance of generated natures, and for the moſt active form of life; but as the whole is undergoing perpetual mutation, the nature of this abundance and of this activity leads to a more ſpeedy termination, and, when terminated, to a more immediate return of parts to their original elements: diſſolution therefore is immediately followed by fermentation. Fermentation decompoſes the moſt minute parts of a body, by which its former properties are totally loſt and others regained;

ed; preparatory perhaps to their becoming ſubſervient to the ſupport of other living bodies, or of returning to their ſeparate elements.

It was the general opinion of phyſiological teachers not long ago, that the digeſtion of the food was effected by the proceſs of fermentation: it is very true that this idea is now for the moſt part given up, although it is ſtill retained by a few. I ſhould aſk theſe, whether it be reaſonable to ſuppoſe that nature would employ the ſame means in aſſimilating dead matter to that which is living, as it does to ſeparate the parts of putrid bodies from each other.

The proceſs of digeſtion is an act of the living principle, for the ſupport of life; the proceſs of fermentation is an act of nature, for the ſeparation of parts after life is at an end.

Nature is an immaterial principle univerſally preſent. Animal or vegetable life is a principle ſuperadded to nature, and limited to a particular ſubject; every living ſyſtem therefore not only contains nature, but the principle of life alſo, the particular quality of which is the cauſe of every form aſſumed by every living ſubſtance. Nature exerts its influence upon all matter alike, having for her object the connection of parts; but the principle of life ſuperadded to every living ſyſtem has for its object not only the preſervation of its parts, but of its organization and form alſo: every living ſyſtem therefore contains not only a form, a nature, and a ſubject matter, whereas inanimate matter contains nature, and ſubject matter only.

CHAP. XV.

ON THE CAUSE OF EARTHQUAKES.

AS pure air is a compound body conſiſting of the matter of heat and of water; and as water, one of its conſtituent parts, is the next in order to the element of earth, and the matter of heat the next in order to the matter of light; it follows, that diſſimilar effects muſt ariſe, according to the particular combination or diſpoſſeſſion of theſe various elements amongſt themſelves.

Fire I have conſidered as produced by the direct combination of different elements—of the matter of light or of air in particular with opake matter, by the diſpoſſeſſion of water; when therefore the matter of light and of earth come in direct contact by the diſpoſſeſſion of air and water, earthquakes are immediately produced. It is a natural reſult of this cauſe, that earthquakes ſhould be immediately followed by partial deluges, and violent wind and rain. It is owing to theſe latter effects that earthquakes ceaſe; they ceaſe by the reſtoration of the media of water and of air, that had been diſpoſſeſſed. Earthquakes therefore will be moſt frequent in very warm and very dry countries, and ſeldom if ever in thoſe that are temperate and wet.

But as I before obſerved, that the element of light is the next to water, and would paſs through it without violence if not intercepted by air or atmoſphere; and as there is neither heat nor vegetation in thoſe countries ſituated near the poles, it is not ſurpriſing that the pure ſolar rays ſhould be occaſionally found directly to unite with land and the earth at the bottom of the ſea, and earthquakes be there frequently produced; and I am informed they occaſionally happen in thoſe regions.

Earthquakes will alſo take place in that part of the ocean that is ſituated under the ſun, cauſed not only by the greater quantity of light, but by the paucity of atmoſphere that there exiſts. I therefore think it very probable, that the numerous iſlands ſituated in the South Sea have been formed by theſe means: their actual exiſtence however, by furniſhing an atmoſphere, will be a ſufficient cauſe to prevent ſuch effects from again taking place.

This want of atmoſphere is an eſſential reaſon why volcanos always burn from the top: it is very probable that the matter contained in the bowels of ſuch mountains is of a very impure kind, and therefore eaſily ignited. Volcanic eruptions may certainly be conſidered as partial earthquakes, and I conceive their exiſtence a ſtrong illuſtration of what I have advanced.

I do not mean to deny but that the combination of various ſubſtances in the bowels of the earth may be ſufficient to produce combuſtion, and conſequent exploſion of the ſurrounding country. Indeed it cannot be otherwiſe ; the changes that take place under the ſurface of the earth furniſh every ingredient for combuſtion ; ſulphur is there found in a native form, and the quantity of alkali and wood produced by the vegetable bodies that have periſhed are all ingredients for the formation of gunpowder : a certain degree of heat therefore is all that is requiſite to ignite ſuch a maſs ; and there can be no doubt that the heat and air evolved in conſequence of fermentation, may be occaſionally found adequate to produce ſuch an effect. Whenever fire is thus produced, and the ſtrata of the materials I have mentioned are in great abundance and of great extent, I ſee no reaſon why ignition ſhould not take place; that earthquakes ſhould be felt far and near;

near ; and that they ſhould happen at the bottom of the ſea as well as on the ſurface of the land.

I have therefore reaſon to believe that earthquakes will ariſe from the direct combination of the pure ſolar rays with the earth, when neither the media of air or water are preſent, and that theſe earthquakes muſt be attended with fire and concuſſion.

If we attend to the hiſtory of earthquakes, as given by the beſt authors, we ſhall find that they happen for the moſt part in very warm countries, where there muſt conſequently be a very great rarity of the air. The phenomenon of the great earthquake at Liſbon in the year 1755 is in point; in 1750, there had been a ſenſible trembling of the earth felt in that city; for four years afterwards there had been an exceſſive drought, inſomuch that the ſprings that afforded a plentiful ſupply of water were totally dried up, and for more than a month before the ſhock the atmoſphere was remarkably clear.

The firſt of November, early in the morning, a thick fog aroſe that was ſoon diſſipated by the heat of the day; there was no wind, and the ſea was perfectly calm; at half paſt nine an interrupted noiſe was heard like thunder, which was followed by the moſt dreadful earthquake, which ſhook the foundations of the city, by which a number of buildings fell; there enſued a pauſe of ſhort duration, and the ſecond ſhock laid the whole city in devaſtation and ruin, with an immenſe deſtruction of its inhabitants; the whole ſhock laſted about ſix minutes.

The world is much indebted to Sir William Hamilton for the pains he has taken to collect from ocular witneſſes the various phenomena that took place in 1783, during the earthquake that laid waſte a great part of Italy and Sicily, and which deſtroyed 40,000 of their inhabitants.

It is not my object to inveſtigate particular effects; but on a review of thoſe that took place during the moſt remarkable earthquakes, I am ſatisfied that they admit of an eaſy ſolution upon the principles I have endeavoured to eſtabliſh during the progreſs of this work. It would take a volume to inveſtigate and refute the various theories that have been advanced on this ſubject: every author who has given the hiſtory of an earthquake has advanced a new theory of it; I mean more particularly the theories of Doctors Stukeley, Prieſtley, and Woodward, Sir William Hamilton, S. Beccaria, and M. Amontons: it is only neceſſary for me to ſay, that ſince they are all different, if one of them is right all the others muſt be wrong.

CHAP. XVI.

ON THE CAUSE OF WATER SPOUTS.

WHENEVER the rays of light come in direct union with the ſea, by the diſpoſſeſſion of air, the preſſure from its ſurface being taken away, the ſea immediately riſes in a long column, forming what is called a water ſpout: the degree of its extent and the velocity of its aſcent will depend on the proportion of abſtraction of air, and the rapidity by which this abſtraction was cauſed. Some navigators relate that they have ſeen ſome of theſe aqueous pyramids near two miles in height: this is not ſurpriſing; for, as they are cauſed by the reſiſtance of the air on the ſurface of the ſea being taken away, the rarity of the medium increaſes in proportion as they aſcend; there would therefore be no termination to their extent, if the baſe were adequately ſtrong for their ſupport: hence they fall, from the nature of their foundation, upon the reſtoration of the medium of air.

This reſtoration of the medium of air may be accompliſhed by two different means: *naturally*, by ſtorms or guſts of wind uniting with the column of water; or *artificially*, by firing into them and breaking the bond of their continuity:

this is a method frequently adopted by navigators.

Theſe phenomena will generally happen at ſea in very hot and calm weather, when there are irregular and partial ſtreams of air: when they take place on land, it muſt be in dry and ſandy ſituations, where the want of atmoſphere permits the rays of the ſun to combine with the ſand, producing heat on the ſurface and a rarity of the medium of air above.

I recollect to have read in ſome book, that in the ſandy deſerts of Arabia it was very frequent to ſee pillars of ſand raiſed in a ſimilar manner to the water ſpouts. That I have aſſigned a true cauſe of theſe phenomena is very ſatisfactorily illuſtrated by what happens in the exhauſted receiver. It is found, that a column of water can be raiſed to the height of 32 feet by the abſtraction of the air it contained: it is frequently aſcribed to the preſſure of the air on the ſides of the veſſels, but it does not appear that there is any additional preſſure; it therefore muſt proceed from the medium of air within being taken away or exhauſted: hence an artificial water ſpout is produced, and which is immediately deſtroyed by reſtoring the medium of air.

Whenever a large quantity of water is collected in the air, and kept ſuſpended by the heat in the form of a cloud; whenever that heat is ſuddenly abſtracted, the body of water ſuddenly falls, owing to the ſpecific gravity of the water to the atmoſpheric medium below.

CHAP. XVII.

ON THE PROBABLE CAUSE OF TIDES.

HITHERTO I have conſidered the earth as placed in the centre of the univerſe, in which it was immoveably fixed, and that the planets and inerratic ſtars were continually revolving round it. The rapidity neceſſary for the motion of theſe bodies may ſeem a ſtrong objection to this hypotheſis: it muſt however be remarked, that the matter of which theſe bodies are compoſed, becomes more excellent and rare as they recede from the centre: and ſuch is the rarity of the medium in which they move, that it ſcarcely affords any reſiſtance to their revolutions.

As ſolidity and inertneſs are eſſential to this earth, rarity and motion muſt be eſſential to the other bodies; and this accounts for the amazing velocity of the rays of light in their paſſage from the ſun to the earth: without however going further into the argument, whether the ſun moves round the earth, or the earth round the ſun, one fact is certain, that the planets not only move circularly, but *in antecedentia et conſequentia*; and out of this fact one effect muſt immediately ariſe. As the moon, in the circulation ſhe deſcribes, is continually leaving the ſpace ſhe occupied, it becomes neceſſary that this ſpace ſhould be filled with ſome medium, otherwiſe a vacuum would take place: the medium of light therefore contiguous to the moon becomes elevated, and the preſſure on the air conſequently diminiſhed; the air therefore follows the light: but as the air follows the light, and by this aſcenſion of both light and air, the reſiſtance on the ſurface of the ſea is alſo abated—hence the ſea follows the air and light, and an elevation of the ſea takes place.

But as the moon completes her revolution ſhe again fills the ſpace ſhe had left in the courſe of her circulation: an effect therefore directly the oppoſite to the former is the conſequence: the moon therefore preſſes back the light, the light the air, and both light and air force down the ſea. Hence it follows, that the motion of the moon muſt produce a conſtant elevation and depreſſion of the ſea, at different times and in different places.

As the ſun is the principal ſource of light, and is the body which fills the upper region with the medium that there exiſts, it is evident that the motion of the ſun, connected with its magnitude, muſt have a very great influence alſo. The increaſed diſtance of the ſun when conſidered with relation to its magnitude will form a counter-action with the moon, which being much nearer muſt neceſſarily be much ſmaller; for if both the ſun and the moon were at equal diſtances, but of unequal magnitudes, an unequal effect would take place: the difference of diſtance therefore I conceive anſwers for the difference of magnitude, and a reciprocal and equal effect is produced: the ſame effect therefore on the ſea muſt take place by the motion of the ſun, as I have attempted to explain by the motion of the moon, namely, that there muſt be a conſtant elevation and depreſſion of the ſea by the motion of the ſun and moon: and may not this be conſidered as the probable cauſe of *tides?*

As neither the ſun nor moon deſcribes perfect circles round the earth, it follows, that they muſt approach to and recede from it more at one time than at another, and when both are in conjunction, the preſſure muſt be greatly increaſed, and when both are in oppoſition diminiſhed; and theſe are the cauſes why the ſea riſes and falls to different degrees of height, and from thence ſpring and neap tides have their appellations.

According to this hypotheſis, tides ought to ebb and flow once only in the twenty-four hours, and then probably up and down rather than ſideways. It is however a fact known to navigators, that the phenomena of tides are limited, not only to the proximity of land, but to certain parts of latitude. In every part of the ocean at the diſtance of 70 or 100 leagues there are no regular tides; occaſional currents are met with, but theſe muſt depend on local peculiarity, ſince they are not regularly conſtant, but differ in the ſame place at different times.

I am credibly informed by thoſe who have frequented the following countries, that no tides take place, viz. in the Weſt

Indies, Caracca Shore, Cape of Good Hope, Iſland of Madagaſcar or Mauritius, Coaſt of Coromandel or Malabar, South America, &c. &c.: there is an elevation and depreſſion at times, but no afflux or reflux; and Major Rennell, in the laſt volume of the Philoſophical Tranſactions, has proved that there is a nothern current ſetting in from the Spaniſh ſhore, along the French coaſt, which was the reaſon that ſhips coming from the Atlantic and ſteering towards the Engliſh Channel were often driven to the northward of it.

If then there is no regularity in the tides at certain diſtances from the land, it is I think fair to preſume, that the elevation and depreſſion of the ocean, connected with the figure of the earth near the ſhore, are the eſſential cauſes for the production of tides.

The tides near the ſhore generally run nine hours one way; farther off they regularly change every ſix hours, and at laſt no tides are found: it therefore becomes a queſtion, whether an elevation or depreſſion alone of the ſea would not happen, if it were not for the influence of the winds, and form of the land, at certain diſtances from the line.

Dr. Halley's hypotheſis, founded as it is on Sir Iſaac Newton's theory of attraction, I conceive to be totally erroneous. Dr. Halley aſcribed the effect to the attracting power of the moon, connected with the diurnal rotation of the earth: it therefore became neceſſary to admit the principle on which that doctrine is eſtabliſhed;

bliſhed: admitting, for the ſake of argument, that it is true, we then find that the law on which it is founded, is, that its force increaſes in proportion as the ſquares of the diſtance decreaſe: the attracting power of the earth over the ſea muſt be infinitely greater than that of the moon, becauſe the ſea is contiguous to the earth, but the moon is 240,000 miles diſtant from the ſea; muſt not then this power be totally effete at this immenſe diſtance? We find the power of this attraction is limited to the ſmalleſt ſpace; for if the particles of a body are removed to a very ſmall diſtance indeed, the bond of union is broken, and a ſeparation of the particles enſues: it is therefore contrary to the moſt common conception of things to ſuppoſe, that the attracting power of the moon could have any effect on the ſea: if it had on the ſea, it would have it on the earth, and ſome ſenſible effects would there be diſcovered.

Since it appears then that the diſtance of the moon from the ſea muſt prevent the attraction here ſpoken of, the difference of magnitude alſo between the earth and the moon manifeſtly proves that it cannot exiſt.

The diameter of the earth is computed to be — — — 7970 miles,

That of the moon — 2180 miles,

and as ſpheres are to each other as the cubes of their diameters, it follows that the earth will be to the moon as

	2180
	2180
	174400
	2180
	4360
	4752400
	2180
	380192000
	4752400
	9504800
Cube of the moon's diameter	10360232000
	7970
	7970
	557900
	71730
	55790
	63520900
	7970
	4446463000
	571688100
	444646300
Cube of the earth's diameter	506261573000
Cube of the moon's diameter	10360232000
Difference of the cube of the earth's diameter above that of the moon	495901341000

It follows therefore that the moon can have no attracting power over the ſea. If however this power be granted to the moon, it muſt be denied to the earth; and if it be denied to the earth, then the earth does not poſſeſs the power of attraction, and the doctrine of gravitation falls to the ground, and repulſion only remains. But it is impoſſible to explain the Newtonian ſyſtem on repulſion alone. If therefore attraction does not exiſt, the doctrine of repulſion cannot be admitted; and thus it is that we are under the neceſſity of abandoning the doctrine of both attraction and repulſion, and of adopting that ſyſtem which admits an immaterial and divine cauſe that pervades all matter, and is the conſtant ſource of the order and regularity of the univerſe.

CHAP. XVIII.

ON THE CAUSE OF CLOUDS, RAIN, DEW, LIGHTNING, AND METEORS.

OUT of the general effect juſt deſcribed of the elevation and depreſſion of the matter of light, air, and water, and from the reſults of the evaporation that conſtantly take place upon the ſurface of the globe, and which conſtitute atmoſphere: ſome degrees of mixture of theſe different elements muſt neceſſarily be the conſequence; for as the atmoſphere follows the matter of light and of air, and water the atmoſphere, theſe different bodies being all of different qualities and of different denſities, a combination between them muſt eventually follow; for there is a phyſical impoſſibility that bodies ſo conſtituted and compoſed, ſhould be preſſed down and elevated in an uniform and regular manner, and for each to preſerve its own identity.

Although evaporation is the general effect of increaſed degrees of heat, either of the ſun or of culinary fires, there is another ſpecies of evaporation that takes place under almoſt every degree of cold we know: the cauſe of the former depends on the difference of the medium; the cauſe of the latter ariſes from the difference of the quality between the medium and the evaporated matter, and is ſimilar to capillary attraction.

The quantity and purity of the rays of the ſun near the ſurface, with relation to this atmoſpheric matter, are relatively ſmall, and the atmoſphere is therefore of a turbid ſtate*. The quantity and purity of the rays of the ſun at a great diſtance from the ſurface, with relation to this atmoſpheric matter, are relatively great: when therefore this atmoſpheric matter arrives at a certain height, and meets the rays of the ſun in a more abundant and uncombined ſtate, a more powerful junction

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* The ſame effect happens to a variety of mixed liquors, ſuch as wine, &c. when expoſed to conſiderable degrees of cold, as they generally become turbid, but when expoſed to heat they become clarified, and recover their former brightneſs.

tion then takes place, attended with a greater degree of heat: the heat thus produced is the reſult of the action of the rays of the ſun with the opake matter; and as heat aſſiſts ſolution, there will be a conſtant collection of water in thoſe parts of the air where heat has been thus produced; and thus it is that clouds are formed: clouds therefore conſiſt of light, the matter of heat, air, evaporated matter, and water.

It is owing to the union of the matter of light and of air with the evaporated matter, that heat is produced in clouds, and which gives them the ſmoky colour they exhibit; and the colour of each is owing to the difference of quantity, and perhaps of quality, of this evaporated matter which different clouds contain.

The reflection of the ſun's rays will neceſſarily have great effect alſo; but there muſt be ſome difference in the quality of two clouds of different colours, when exiſting nearly in the ſame place, and viewed through nearly the ſame medium.

As heat is one of the cauſes of evaporation, and the matter of heat (with ſome few exceptions) is limited to a certain diſtance, it follows, that the whole matter of which clouds are compoſed muſt be limited alſo.

The medium below the clouds is water, opake matter, air, heat, and light.

The medium to a limited diſtance above the clouds, is water, air, heat, and light.

The medium above this is light alone.

Clouds therefore cannot aſcend beyond a certain height, becauſe they become ſpecifically heavier than the medium; neither can they deſcend altogether upon the ſurface of the earth, not only on account of the heat at a certain diſtance cauſed by the ſun's rays with the opake matter, but becauſe the atmoſphere near the ſurface is ſpecifically more denſe than the clouds; hence therefore they remain buoyed up at a medium diſtance.

It follows therefore, that clouds are more turbid in their appearance than the atmoſphere, and the atmoſphere more turbid than the medium above the clouds.

As the matter of heat is an eſſential cauſe for evaporation, and as there is more heat in ſummer than in winter, clouds will be much higher, and contain more evaporated matter at that ſeaſon, and will contain more water, and be lower in winter. Whenever the matter of heat is diminiſhed, and which is one of the cauſes why clouds are kept ſuſpended, or whenever they contain a greater quantity of water than the medium will allow, a depoſition muſt follow, conſtituting *rain*.

Whenever a quantity of water is evaporated by the heat of the day, and which is kept ſuſpended in the atmoſphere; when an abſtraction of that heat takes place, a depoſition muſt enſue, and this is the cauſe of dews; and as the ſun is abſent at night, night muſt be generally colder than the day, and therefore we find it the ſeaſon for dews.

As the clouds contain a quantity of opake evaporated matter, which ſerves as fuel for the matter of light, the heat there produced is of a much purer kind than that which is the reſult of culinary fires. The fire there excited is the electric fire: electric fire contains a greater proportion of the matter of light than opake matter; culinary fire contains a greater proportion of opake matter, and a leſs quantity of the matter of light: in every other reſpect they are the ſame.

As the matter of light and of heat (owing to the more continued preſence of the ſun), as well as the quantity of evaporated matter, is more abundant in ſummer than in winter, we find meteors and lightning more frequent in the former than the latter ſeaſon, in warm countries than in cold, and in the evening more than the morning.

Lightning however muſt in general be more dangerous in the winter than in the ſummer, becauſe clouds, which furniſh one of the conſtituent parts for lightning, are then much nearer the ſurface of the earth.

The quantity of water contained in the clouds and the medium below, makes them the region for rain, and its modifications of dew, hail, and ſnow.

The region of clouds, owing to the greater power of the rays of the ſun, and the *occaſional* increaſed quantity of opake matter, makes it the region for lightning.

The ſummit above the clouds is the region for meteors and comets, owing to the abſence of water. Rain therefore is more opake than lightning, lightning more opake than the meteors we behold at a great height, and comets more luminous than all. Meteors are produced by a quantity of opake matter that has eſcaped from the ſummit of the clouds, having involved with it a quantity of the matter of light: the whole of this maſs was kept in a paſſive ſtate by the water the cloud contained; but when it got out of the cloud it became ignited as it were *per ſe*, and continued burning during the whole of its aſcent. I conceive this accounts very ſatiſfactorily for the immenſe height to which meteors have been diſcovered; it is ſaid, at 42 miles from the ſurface of the earth.

Whenever a maſs of this nature eſcapes from the lower part of a cloud, it falls inſtead of aſcending; fire-balls therefore are very common in violent rains, becauſe the water in the lower part of a cloud is depoſited, and hence the ſuperior part of the cloud becomes ſpecifically heavier, and the atmoſphere below ſpecifically lighter. The whole maſs therefore is carried along with it.

Meteors cannot exiſt beyond a certain diſtance from the earth, becauſe the opake matter which they contain cannot aſcend beyond the relative rarity which the medium will allow. There is however a neceſſity for the conſumption of this opake matter, that the purity of the medium may be preſerved: hence a luminous fire is there produced, until the whole maſs is diſſipated and burnt.

Meteors therefore are ſimilar to lightning in point of quality, but ſomewhat different in reſpect to the phenomena they exhibit. Meteors are *collected* maſſes of combuſtible materials, acted upon collectively by the matter of light and of air. Lightning ariſes from evaporated matter *diffuſed* in the clouds, ignited by the matter of light and of air alſo. When the air in theſe clouds is thus conſumed, it loſes its elaſticity alſo; thunder therefore I conceive to ariſe in conſequence of the loſs of this elaſticity, cauſed by the lightning, and that hence a greater reſiſtance is made to ſuch clouds when they meet.

CHAP. XIX.

ON COMETS.

THE laſt effect of the motion of the heavenly bodies, and the mixture of the different elements, is between the ſummit of air and the pure matter of light. There is as much difference in point of purity between light and air as there is between water and earth. However pure the air may be in that elevated region, with relation to the air near the ſurface of the earth; yet being a compound fluid, it follows, that air is opake with relation to the homogeneous nature of the element of light; and as combination ariſes from the difference of quality of different bodies, it follows, that a junction muſt take place between the ſummit of air and the rays of light in their elementary ſtate. In the infinite progreſſion of time the region of pure light therefore would either become a turbid or a fiery medium, if nature had not provided a remedy for this evil—a remedy ſo well adapted to the nature of the diſeaſe, that it muſt ever prove effectual; and I conſider that comets are the inſtruments that are allotted to prevent the miſchief that would otherwiſe enſue.

As the combination that takes place is ſituated in the moſt excellent medium, where the matter of light is in its moſt vivid and powerful form, and the aerial matter itſelf of a very pure kind, it follows, that the fire produced in conſequence of this combination muſt be of the moſt luminous nature.

As the motion of the heavenly bodies is regularly continued, and that region is not expoſed to the influence of winds, rain, &c. it follows, that this turbid ſtate muſt be there perpetually taking place in an uniform and regular manner.

Again, as the atmoſphere is more opake than the ſummit of air, ſo the portion of air which forms the ſummit of atmoſphere is more opake than the ſummit of air contiguous to the element of light;

hence there is an abſolute neceſſity that bodies of a very extended and longitudinal form ſhould exiſt, becoming progreſſively broader from the apex to the baſe, by means of which they might occupy a larger lateral ſpace, for the purpoſe of uniting with and conſuming the aerial matter that has aſcended beyond its true element.

If ſuch bodies as comets did not exiſt, two effects muſt follow:—the region of light would be perpetually rendered impure, and the quality of the medium neceſſary for the regular motion of the heavenly bodies would be diſturbed. If this medium could be rendered obſcure, the earth and the planets would loſe the benefit reſulting from the ſun;

and if it could be rendered more denſe at particular times, the regularity of the motion of the heavenly bodies would be diſturbed, and a total derangement of the univerſe would follow.

The providence of God therefore, by the ſupreme knowledge of cauſes and of conſequent effects, foreſeeing the diſeaſe applies the cure: hence comets are deſtined to conſume any impure ſubſtance that may have inſinuated itſelf in the region of pure light; and through their means the purity of that region, and the medium for the regularity of the motion of the heavenly bodies, are preſerved.

According to this opinion, there does appear to me an abſolute neceſſity for the exiſtence of different comets of different claſſes, that deſcribe different orbits,

bits, and make their appearance at different times *:

Sir Iſaac Newton's opinion therefore is erroneous, "that the planets are influenced by the comets, and that from "the tails of the latter ſome of the finer "parts of our atmoſphere are produced." It is the very reverſe; it is the finer parts of our atmoſphere that produce the groſſer parts of the higher region, and which comets are intended to conſume for the purpoſe of keeping it pure, and to prevent

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* In the laſt volume of the Philoſ. Tranſ. the Rev. Edward Gregory relates the hiſtory of a comet he had diſcovered the 8th of January, 1793. I have no doubt that the inferior part of the medium of light abounds with them alſo, and it is only a proof of the inſufficiency of ocular obſervation that they are ſo ſeldom diſcovered.

vent it from exerting any influence on the planets.

I reaſon from the phyſical neceſſity of the caſe, and not from any aſtronomical knowledge I have of the ſubject. At the time I was reflecting on the motion of the planets, I ſaw the effect it muſt have in producing an elevation and depreſſion of the ſea, and the mixture of atmoſpheric matter in the region of light; I therefore perceived that my idea was altogether wrong, unleſs nature had provided for the evil that muſt enſue in the region of light; and it was then only that the idea of comets, and the objects for which they exiſted, occurred to me: the ſyſtem therefore appears to me complete, not only as a whole, but with relation to its parts.

There is however one objection that may ſeem to ſome to have great weight, viz. If the aerial matter in the region of light, in combination with the rays of the ſun, be the cauſe of comets, it might ſeem reaſonable to ſuppoſe that comets ought to extend to the bottom, and perhaps conſume the earth itſelf, ſince this opake matter continually increaſes in quantity towards the ſurface of the earth: a little attention however will clearly ſhew that there is no danger of this conſequence enſuing, and that they muſt be limited to the upper region.

The rays that are emanated from the ſun gradually loſe their power as they approach the earth, in conſequence of the increaſed quantity of atmoſpheric matter they meet with: increaſed combination therefore produces decreaſe of power: hence heat is there produced inſtead of flame, and both are the ſame in quality, only different in degree: in the firſt caſe it is the cauſe of clouds, in the laſt of meteors and comets. The ultimate extent of the column of atmoſphere cannot very eaſily be aſcertained; but by geometrical calculation it is known to be of an immenſe height; it is alſo known that it gradually becomes purer and rarer until it is loſt in the region of light: here then is the cauſe of the limitation of comets. Whenever the column of atmoſphere becomes more opake by containing more atmoſpheric matter than the rays of light can ignite, comets there find their boundaries: comets therefore are in their nature fiery, conſiſting of the pure matter of light in combination with the aerial fluid which has aſcended beyond its true region, in conſequence of the motion of the heavenly bodies.

Comets are deſtined to conſume any opake matter that may have riſen beyond its proper bounds, and to preſerve the true region of light in a pure and uncontaminated ſtate: hence it follows that there are ſublunary comets.

If there are comets amongſt the higher planets, it throws much light upon the nature of the matter of which they are compoſed, ſince it ſhews that it is of an earthy nature, and that they have atmoſphere as well as this earth; their atmoſphere probably is infinitely rarer and purer than our own : the comets therefore ſubſervient to the preſervation of their medium muſt move infinitely more rapidly, and be infinitely more brilliant than thoſe of a ſublunary nature.

CHAP. XX.

CONCLUSION.

HAVING traced the various proceſſions of the elements, it now remains for me to apply them to the purpoſe for which they were deſtined: they were deſtined for the uſe of man, and the other orders of generated nature. As man ſtands the firſt, " midway from nothing to the Deity," the laſt of intelligibles, but the firſt in the order of ſenſibles, it follows, that it is he who is the proper

object

object for the conſumption of the beſt productions of the different elements.

Although the various orders of beings are generally claſſed into animal, vegetable, and mineral, and man and animal are put in the ſame claſs; and however their general properties as animals may agree, their peculiar attributes are infinitely different: this difference principally conſiſts in man having an immaterial and immortal ſoul, in an animal body, which it employs as an inſtrument: this is the proper definition of man: man therefore partakes of animal, although brute does not partake of the moſt excellent attribute of man.

Man therefore ſtands erect, inhaling the air at ſome diſtance from the ground: brutes, having their mouths turned to the ground, on which they feed, inhale the noxious vapours from the impure ſurface; but vegetables inhale air that is totally impure, and minerals abſorb without exhaling.

Having divided the primary elements into three, namely, light, water, and earth, it became neceſſary that there ſhould be three claſſes of animals for their habitation; hence we find there are terreſtrial, aquatic, and aerial animals. It appears to me that the firſt proceſſion ought to take place from man to quadrupeds; the ſecond proceſſion from birds to fiſh and the amphibia; and the third proceſſion from vegetables to minerals.

Man therefore being at the head of

terreſtrial animals, will inhale air more pure than they; for fixed air, which is found to be immediately deſtructive to human exiſtence when inhaled, being ſpecifically heavier than any other kind of air, muſt be found abundant near the ſurface; and as the experiments of Dr. Ingenhouſz have proved that vegetables emit a large quantity of bad air during the night, and as it is natural for moſt animals to be expoſed to its influence, it follows, that animals during the act of feeding in the day muſt inhale a large proportion of it; and at night alſo during the ſtate of reſt.

Nature ſeems to have been very careful to protect the human ſpecies from the danger of inhaling the air near the ſurface.

face. Although all animals are capable of acting after being born, yet it is the human ſpecies alone perhaps that is helpleſs, and obliged to be carried by its nurſe, until the body has attained a ſufficient ſize to enable it to inhale air at a ſufficient diſtance from the ſurface, and it then becomes capable of managing itſelf. The Cavo del Cane in Italy is a ſtrong illuſtration of this opinion: the mephitic air is there collected in great abundance, but on account of its ſpecific gravity it does not aſcend more than 12 or 18 inches above the ſurface. When a dog enters the cave and inhales the air, he is immediately poiſoned, although a man may go in without danger: if infants therefore were able to walk as ſoon as born, or if they took their food from the ſurface, it is evident they would be expoſed to the ſame danger.

As this is the proceſſion of inſpiration allotted to the different claſſes of generated natures, let us next examine the different qualities of the expirations; here we ſhall find the chain beautifully continued, illuſtrative of the oppoſite effects reſulting from mutation.

Man therefore inſpires partly pure and partly impure, and expels totally impure air.

Brutes inſpire partly pure, partly more impure, and expel air more pure than man.

Vegetables inhale impure air entirely, and expel entirely pure air.

Minerals contain materials only for impurity *.

If

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* Every man can judge for himſelf the neceſſity of freſh air, and the foulneſs he emits by expiration, and the experiments of Doctors Prieſtley and Ingenhouſz prove very decidedly the purifying power of vegetables; I ſhall however relate, in Doctor Prieſtley's own words, his own experiment. "In "no other circumſtances have I ſeen vegetation ſo "vigorous as in this kind of air (meaning phlogiſ"ticated air), which is immediately fatal to animal "life. Though theſe plants have been crowded in "jars filled with this kind of air, every leaf has "been full of life; freſh ſhoots have branched out "in various directions, and grown much faſter than "other ſimilar plants growing in the ſame expoſure "in common air." Having, in conſequence of this obſervation, rendered a quantity of air thoroughly noxious by mice breathing and dying in it, he divided it into two receivers inverted in water, introducing a ſprig of mint into one of them, and keeping

If therefore the firſt and the laſt be connected, we ſhall find the circle of mutation completely deſcribed, and where purity begins impurity has its end. From the order and regularity in the operations of nature a regular proceſſion of beings muſt take place from man to brutes, from brutes to vegetables, from vegetables to minerals, from minerals to the laſt material proceſſion itſelf. It is at this point (if I may ſo call it) that nature begins, uniting the perfect with the imperfect, containing all things, and weaving them in one bond. Nature therefore, although ſuperior

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ing the other receiver unaltered. About eight days after, he found that the air of the receiver, into which he had introduced the ſprig, had become reſpirable; for a mouſe lived well in this, whereas it died the moment it was put into the other.

ſuperior to the firſt matter, is the laſt of thoſe incorporeal cauſes by which the world was fabricated, and is the cauſe of generation, nutrition, and increaſe. I ſhall extract a paſſage out of Ammonius, which, if well ſtudied and underſtood, will give the reader a very accurate idea of nature.

"Conceive a ſeal ring which has the image of ſome particular perſon, for inſtance, of Achilles, engraved on its ſeal, and let there be many portions of wax which are impreſſed by the ring: afterwards conceive that ſome one approaches and perceives all the portions of wax which are ſtamped by the impreſſion of this one ring, and keeps the impreſſion of the ring in his mind; the ſeal engraved in the ring repreſents the univerſal PRIOR TO THE MANY; the impreſſion in the portions of wax the univerſal IN THE MANY: but that which remains in the intelligence of the beholder may be called the univerſal AFTER OR POSTERIOR TO THE MANY; the ſame muſt we conceive in genera and ſpecies. For that beſt and moſt excellent artificer of the world poſſeſſes within himſelf the forms and exemplars of all things; ſo that in the fabrication of man, he looks back upon the form of man reſident in his eſſence, and faſhions all the reſt according to its exemplar. But if any one ſhould oppoſe this doctrine, and aſſert that the forms of things do not reſide with their artificer, let him attend to the following arguments: The artificer either knows or is ignorant of that which he produces; but he who is ignorant will never produce any thing: for who will attempt to do that which he is ignorant how to perform? ſince he cannot act from an irrational power like Nature (whoſe operations are not attended with any animadverſions): but if he produces any thing by a certain reaſon, he muſt poſſeſs a knowledge of every thing which he produces. If therefore it be not impious to aſſert that the operations of the Deity, like thoſe of man, are attended with knowledge, it is evident that the form of things muſt reſide in his eſſence. But forms are in the demiurgus like the ſeal in the ring, and theſe forms are ſaid to be PRIOR TO THE MANY, and ſeparated from matter. But the ſpecies man is contained in each particular man like the impreſſion of the ſeal on the wax, and is ſaid to ſubſiſt IN THE MANY without a ſeparation from matter. And when we behold particular men, and perceive the ſame form and effigy in each, that form ſeated in our ſoul is ſaid to be AFTER THE MANY, and to have a poſterior generation; juſt as we obſerved in him who beheld many ſeals impreſſed on the wax from one and the ſame ring; and this one POSTERIOR TO THE MANY may be ſeparated from body when it is conceived as not inherent in body but in the ſoul, but is incapable of real ſeparation from its ſubject*."

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* Intelligatur annulus, qui alicujus, utpote Achillis, imaginem inſculptam habeat; multæ inſuper ceræ

Having gone thus far, the ſubject would naturally lead me to the contemplation

ceræ ſint, et ab annulo imprimantur; veniat deinde quiſpiam, videatque ceras omnes unius annuli impreſſione formatas, annulique impreſſionem in mente contineat. Sigillum annulo inſculptum ANTE MULTA dicitur; in cerulis impreſſum, IN MULTIS; quod vero in illius qui illo venerat intelligentia remanſerit, POST MULTA, et poſterius genitum dicitur. Idem in generibus et formis intelligendum cenſeo: etenim ille optimus procreator mundi Deus omnium rerum formas atque exempla habet apud ſe; ut ſi hominem efficere velit, in hominis formam quam habet intueatur, et ad illius exemplum cæteros faciat omnes. At ſi quis reſtiterit, dicatque rerum formas apud Creatorem non eſſe; quæſo ut diligenter attendat: Opifex quæ facit vel cognoſcit vel ignorat: ſed is qui neſcit nunquam faciet: quis enim id facere aggreditur quod facere ignorat? Neque enim facultate quadam rationis experte aliquid aget, prout agit Natura (ex quo conficitur ut Natura etiam agat, etſi quæ

plation of the other parts of the univerſe and the nature of their inhabitants—I mean of the celeſtial regions and the incorporeals they contain—for as yet we

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quæ faciat non advertat): ſi vero ratione quadam aliquid facit, quodcunque ab eo factum eſt, omnino cognovit. Si igitur Deus non pejore ratione, quam homo, facit quid, quæ facit cognovit: ſi cognovit quæ fecit, in ipſo rerum formas eſſe perſpicuum eſt. Formæ autem in opifice ſunt perinde, ut in annulo ſigillum, hæcque forma ANTE MULTA, et avulſa a materia dicitur. Atqui hominis ſpecies in unoquoque homine eſt quemadmodum etiam ſigilla in ceris, et IN MULTIS nec avulſa a materia dicitur. At cum ſingulos homines animo conſpicimus, et eandem in unoquoque formam atque effigiem videmus, illa effigies in mente noſtra inſidens POST MULTA et poſterius genitum dicetur; velut in illo quoque dicebamus, qui multa ſigilla in cera uno et eodem annulo impreſſa conſpexerat. Ammon. in Porphyr. Inter. p. 29.

have only conſidered man as holding a diſtinguiſhed rank in being's endleſs chain—"midway from nothing to the Deity."

The laws of the univerſe imply a regular ſubordinate order of beings, and any man who underſtands theſe laws would immediately ſay *a priori* what obſervation proclaims. Since it appears then that there is this order of ſubordination in the ſenſible world, ſhall we ſay that it there ſtops? or ſhall we not rather ſay, that man, although the firſt of ſenſible natures, is the laſt of incorporeals? that by ſoul indeed he is allied to incorporeals, but by his animal nature he partakes of the brute?

We may therefore conclude, that the whole viſible world exhibits nothing more than ſo many paſſing pictures of the *immutable forms* that exiſt in the intelligible world: that through theſe it attains a ſemblance of immortality, and continues through ages to be *ſpecifically one* amid thoſe infinite particular changes that befall it every moment. May we not be allowed alſo to credit thoſe ſpeculative men who tell us, *It is in theſe permanent and comprehenſive* FORMS that the *Deity* views at once, without looking abroad, all poſſible productions *both preſent, paſt, and future: that this great and ſtupendous view is but a view of himſelf, where all things lie enveloped in their principles and exemplars, as being eſſential to the fulneſs of his univerſal intellection?*

If this be the caſe, the axiom therefore, Nil eſt in intellectu quod non prius fuit in ſenſu, *muſt*

muſt be reverſed, and we muſt now ſay, Nil eſt in ſenſu quod non prius fuit in intellectu.

The proper ſtudy therefore of mankind is man—not of the brutal part of man, but of ſoul, its operations and attributes; this is true philoſophy, the proper purſuit of the wiſe for the acquiſition of truth. Man therefore ought to begin by the contemplation of the nature of his own ſoul; this will qualify and elevate him for the knowledge of the ſublime regions—the ſeat of intelligible beings, who having lived a pure and holy life, energize there according to a pure intellect (i. e. *the ſeat of juſt men made perfect)*: from this he will be led through the various orders of the hierarchy, from ſoul to angels and arch-angels, from theſe to cherubims and ſeraphims, till he arrives to Deity itſelf, to Jehovah, the Demiurgus of the univerſe—the Alpha and Omega—who is over all, through and in all.

O quam dilecta ſunt tua opera!
Indoctus non cognoſcit ea,
Stultus non comprehendit ea.

APPEN-

APPENDIX.

NOTWITHSTANDING the aſſertion of the materialiſt, "That every thing is the "reſult of organization;" the whole phenomena of ſociety are carried on by two ideas that have nothing in common with organic matter; I mean the idea of *time* and the idea of *number*: with regard to the firſt, Mr. Harris in his Hermes has fully inveſtigated its nature; and as to numbers, none underſtood them better than Pythagoras and his followers. I ſhould not however do juſtice to the ſubject I have inveſtigated, did I neglect to point out to the reader, how univerſally I found the number *three* to pervade the whole creation. The firſt Great Triad is that in whoſe name every Chriſtian is baptized, the Father, the Son, and the Holy Ghoſt; for ſuch are the names revelation adopts to expreſs that Trinity in which moſt nations have believed, and to which the generality of religions have been adapted.

The Heathen have deſigned it by Goodneſs, Intelligence, and Vitality: the Schoolmen, by Will, Energy, and Wiſdom: the Jews adored a God *thrice holy*; on which account their *Sanctum Sanctorum* was called their *Holy of Holies*: the Bramins have their Trinity; the Chaldeans had theirs, as it would be eaſy to prove did we wiſh to purſue that ſubject. But to deſcend from God to Nature let us now obſerve, that there is a Firſt Triad, with reſpect to this world.

Firſt Proceſſion.

1. Providence,
2. Nature,
3. Univerſe.

Second Proceſſion.

1. Element of Light,
2. Element of Water,
3. Element of Earth.

Third Proceſſion.

1. Of Fire,
2 Of Air,
3. Of Cold.

Beings are divided into,

1. Animals,
2. Vegetables,
3. Minerals.

1. Terrene Animals,
2. Aquatic Animals,
3. Aerial Animals.

In Man there are Three Subjects,

1. Soul,	*in which reſide*	Intellection,
2. Nature,		Vegetation,
3. Body,		Form.

In the Second Order of Animals, or Brutes and Vegetables, there are Two Subjects,

1. Nature,	*in which reſide*	Vegetation,
2. Body,		Form.

In the Third Order, or thoſe of Minerals, reſide,

Form, and total Negation of Action or Paſſion.

But Properties of Matter are,

1. Length,	*having*	Beginning,
2. Breadth,		Middle,
3. Thickneſs,		And an End.

The object of univerſal generation is *the production of a third.*

IN

In the Science of Government the Three most prominent Distinctions are those of,

1. Monarchy,	*implying*	1. Execution,
2. Ariſtocracy,		2. Legiſlation,
3. Democracy,		3. Deliberation.

The proper Procession of these is,

1. That the Monarchy ſhould command,
2. That the Ariſtocracy ſhould command and be commanded,
3. That the Democracy ſhould obey.

The Result by Procession is,

1. The Monarchy loves,
2. The Ariſtocracy loves and honours,
3. The Democracy loves, honours, and obeys.

The Order by Inversion.

1. The Monarchy obeys,
2. The Ariſtocracy commands and is commanded,
3. The Democracy commands.

THE RESULT BY INVERSION.

1. Equality,
2. Murders and Confuſion,
3. Murders, Confuſion, and Civil Wars.

Ranks in Families.

1. Father,
2. Mother,
3. Children.

Second Proceſſion.

1. Maſter,
2. Miſtreſs,
3. Servants.

Profeſſions of

1. Divinity,
2. Phyſic,
3. Law.

General Diviſion of Religion.

1. Chriſtian,
2. Unitarian,
3. Materialiſt.

Reſult.

1. The Chriſtian worſhips the Father, Son, and Holy Ghoſt,
2. The Unitarian, the Father,
3. The Materialiſt, total privation.

Hence it follows that,

1. The Chriſtian is a Royaliſt,
2. The Unitarian a Republican,
3. The Materialiſt an Anarchiſt.

Thus have we traced No. 3. through every part of nature: happy will it be for thoſe who know how to diſtinguiſh it in themſelves: the whole ſoul may be divided into truth, conſcience, and common ſenſe—that principle of divinity which is common to all men, who have derived it from one common and immortal Father. The inferior part of man is his animal nature, which is a principle alſo common to all, and not in the power of any to alter. Between the two principles, intellect and ſenſe, lies the region of paſſion, genius, and character; and this it is that diſtinguiſhes the individual from the ſpecies, and that may be debaſed or elevated as we chooſe to indulge intellectual or ſenſual affections: this it is that we are called upon to purify and improve, firſt by goodneſs, and then by knowledge.

THE END.